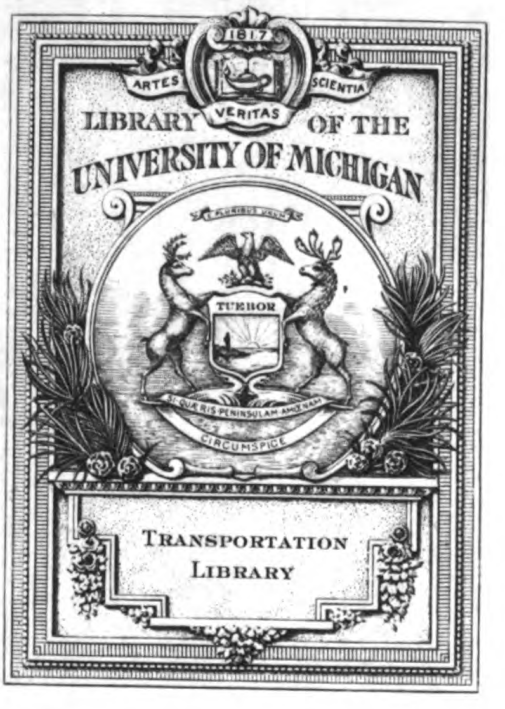
HE'S IN THE ENGINEERS NOW

BY CARL MANN



HE'S IN
THE ENGINEERS NOW

The fighting engineers—they build until they have to fight, and then they fight like tigers.

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CARL MANN

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CARL MANN.

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INTRODUCTION

THE ENGINEERS ARE ON the warpath! They are fighting for keeps. They are dedicating every ounce of their know-how, skill and energy to one single task—Victory. They are doing their share the hard way, with blocks of dynamite and TNT, picks and shovels, miles of copper wire, bulldozers, gadgets, cranes and scrapers, surveying instruments, sledge hammers, carpenters' levels, pontoon boats, trucks, trailers and tractors.

The new Army's engineers have taken America's peacetime working tools and have made them talk war's language—a language the Axis is just beginning to understand. They are flinging bridges across turbulent rivers, building airports and cantonment cities in reclaimed jungle swamps and on the rim of the Arctic. They have carved the great Alaskan highway out of the wilderness in record time. And these amazing feats will be topped by many others before the war is ended.

The engineers are not fighting with tools alone. They can drop working tools in an instant, grab a Garand rifle and hit a bull's-eye with the first shot. At this moment, in far-off corners of the globe, in steaming tropical islands and on icy, wind-swept barren wastes, engineers are alternating this tense life-and-death pattern of soldier existence with turns at an anti-aircraft gun or on the business end of a machine gun, standing off sneak ground attacks. They make up an efficiently designed, hard-slugging machine that can throw a bridge across a stream or river under a canopy of blazing enemy fire and blow that same bridge to kingdom come at the precise split second of a battle, if circumstances dictate.

No branch of the Army has a richer heritage. The Corps of Engineers trace their history back to George Washington, who proved

that he, too, recognized the vital rôle of the engineer in the life of a nation, whether it was in peace or war.

There is not a single home in America that has not benefited, directly or indirectly, from the persistent and resolute courage of these gallant soldiers and the thousands of dams, locks, bridges, highways and railroads they have mapped, charted, built and turned over to their nation as milestones on the road to the future.

Now that American forces are fighting from pole to pole, the Corps of Engineers, striking in unison with other components of the Allied Armies, are showing the world the power of Yankee ingenuity when it is applied to war. The military engineers frequently mentioned in dispatches from Australia, New Guinea, China, Alaska, Greenland, Panama and scores of other remote points are the same engineers who only a few months before were building the highways, railroads, skyscrapers, radios, automobiles and airplanes geared to the peaceful pursuit of progress. But they are taking the war in their stride.

The U.S. Army engineers are not supermen. They are simply strong, healthy, clear-eyed, determined Americans from Main Street of your home town. They are the choir boys and mechanics from Detroit; the butchers and bakers from Kansas City, Tulsa and Denver; the quarterbacks from Purdue, Northwestern or Michigan State. They do not go in for high-powered talk of how tough a man has to be to get into the Corps of Engineers. They know they have a job to do, know what its importance is and what it will take to accomplish the task. And they know they will have to perform this bitter but necessary job with the tools they carried with them when they were inducted into the Army.

These tools were native intelligence and a good sound physical structure that would stand a certain amount of knocking about and would take discipline and general improvement scientifically prepared in advance to make the Corps of Engineers an effective arm of the Army team. The process of being knocked about, disciplined and generally improved for a purpose comes in regularly prescribed doses at frequent intervals, as you will see when you follow the recruit through his training.

HE'S IN
THE ENGINEERS NOW

Chapter One

ORGANIZATION

A MILLION ENGINEERS! That will be approximately the number of engineer soldiers and officers in the Army by 1944. With an army of 10,000,000 men, the ratio of engineers runs something like one engineer to nine soldiers in the other arms and services. This is an amazing set of figures when stacked beside that pitiable-looking handful of experts numbering seven or eight that General George Washington assembled in 1776. But this is an incredible war, a vicious war, a global war—not a skirmish between two little bands of ill-clothed, poorly fed redcoats and Yankees.

The organization of the Corps of Engineers is a gigantic structure that reaches from the office of the Chief of Engineers in Washington to isolated command posts in the jungles of New Guinea and to the GHQ of the Allied fighting forces on the African desert. To name all of the various types, sizes, duties and functions of all the complex fighting units, and enumerate the skills, specialists, scientific men and professional phases of the Corps' operations would take a good-sized book in itself. But it is fascinating to look at the highly organized framework of the Corps of Engineers.

These fighting builders, whose job it is to make the going easier for their own troops by clearing roads and erecting bridges, must be just as proficient in destroying the same facilities to impede the advance of the enemy. They may be found working far to the front of their own troops, or to the rear maintaining supply and transportation systems. And, when it becomes necessary, the engineers

can drop their tools and hold their own with a rifle side by side with the infantry.

The engineers build, repair and maintain structures of nearly every kind. They carry on these building jobs both at home in training areas and in the theater of operations. They construct fortifications for their own troops and demolish enemy strongholds. They lay mines, and explode those laid by the enemy. They blow up bridges, destroy captured guns and materiel. And to all this they may add such duties as operation of railroads, electric systems and water systems and making of maps for all branches of the Army. So versatile is the work of the Corps of Engineers that advice on engineer operation is made available to commanders throughout all echelons of the Army.

In the staff of a division and in the higher units there is always an engineer section. In the division the engineer staff officer also commands the engineer component of the division. While the engineer staff officer in the Army Corps and higher units is charged with technical staff duties only, it is assumed that Army Corps and Army engineer staff officers will be expected to direct the operations of Corps and Army engineer units, respectively.

Likewise, engineer units are sprinkled throughout the Army. For example, each division (infantry, armored force or cavalry) has its engineer battalion. This battalion is organized, equipped and trained for the "combat engineering" required in front-line operations.

Farther to the rear are many other engineer units, some of them organized, equipped and trained for general engineer work; some for special work. In the Army Corps, for instance, there are regiments that can be given almost any type of mission, and in the Field Army there are others trained for specific purposes, such as pontoon companies to transport and maintain the Army's pontoon and trestle bridges, and map reproduction battalions to reproduce maps and charts.

Developments in modern war have greatly increased the impor-

An assault detail working its way across a stream to storm a bridgehead on the opposite bank. When a Signal Corps photographer caught these three engineers it was only a practice maneuver but the expressions say, "Try and stop us.'

tance of engineer operations. The mobility of modern armored columns is often directly dependent on the ability of engineers to keep the way open and cleared of obstacles. The engineer must often operate in exposed positions, cross unfordable waterways and seize and hold important bridges.

When the army takes a cross-country move the engineers are just about the top dog in the whole operation. Maps made by the engineers mark the route to be followed. Roads which they have built may carry the motorized forces and the army's supplies. The Army moves across bridges the engineers built. In the event rails are laid to the base of operations, the engineers lay them and then run the trains. When a bridgehead is to be established in enemy territory, the engineer gets the call. He plants mines and tank traps. His camouflage protects the artillery positions and supply dumps. Engineer detachments protect the flank of an advancing column by erecting obstacles or laying mines. And they inflict serious delay upon the enemy by demolishing bridges as if they were match sticks and ripping up roads as a farmer plows a furrow. These tricks they do with explosives. Dynamite and TNT are strictly engineer property, and the engineer uses them with the deftness of a surgeon.

The engineer of today, by the rapid development of motorized vehicles and power tools, is almost a mechanical combination of wizard and monster, with a dash of magician. Yet despite the motor vehicle and his modern power apparatus, the engineer still frequently finds the opportunity to pick up his old faithful pick and shovel. In a pinch, when the enemy puts on the pressure, the engineer can, by his efficient and thorough training, deliver death and destruction via the machine gun and the Garand rifle.

There are four new and important types of engineer units: the combat battalion of the Armored Division, the airborne and aviation battalions of the Air Forces Combat Command, and the Engineer Amphibian Command. The armored force could not move an inch, forward or backward, if it did not have its combat engineers bat-

talion. The airborne engineers and aviation engineer battalions maintain and defend all military airdromes. The amphibian engineers are a combination land-water force trained to get men from ship to shore, or from one shore to another over small water distances.

To meet the constant need for highly trained engineer personnel, the Engineer School at Fort Belvoir, Virginia, provides instruction to selected officers and enlisted men in modern engineering assault tactics. Courses are also included for National Guard and Reserve officers, to prepare them to take their place in the Army when called to duty.

The Engineer Board, with headquarters at Fort Belvoir, is composed of officers, enlisted men and some civilians whose function is research and development of engineer equipment. While the main body of the Board is located at Fort Belvoir, there is a detachment at Wright Field, Ohio, which works with the Air Forces on mapping problems. There is also an anti-aircraft searchlight mirror plant at Mariemont, Ohio, under supervision of the Engineer Board.

Not all of the engineers' work, however, is confined to military functions. Fully a third of the tasks of the engineers has to do with construction and civil activities. Many of the great public structures, such as the Washington Monument, the Capitol and the Library of Congress, were built by the engineers. There is also the Panama Canal, and lately the Alaskan-Canadian Highway. All navigation improvements and most of the flood-control projects are supervised and completed by the Corps. Engineer officers hold many important places in various government agencies, such as the Economic Warfare Board headed by Vice President Henry Wallace.

"The Corps of Engineers has played a vital part in all our wars, and there is no doubt that the engineers in the present war will meet greater and more varied demands than ever before," Lieutenant General L. J. McNair, Commanding General of the Army Ground Forces, told a young graduating class of officers not long ago. "War today," he said, "involves a vast amount of science, yet

Colored engineers take time out for a taste test. Many colored troops are in the Corps. They've left jobs as bellboys, truck drivers, elevator operators, and school teachers, to win a position of esteem in the engineer ranks. Many colored troops stood the test on the Alcan road.

equally if not more so it includes intense activity of the rough and tumble sort, highly practical. Above all, the tempo of war today is far faster than ever before. Fast thinking and acting both are essential. You have fine men and modern equipment in your engineer units, but will you be able to make the best possible use of them? Will they be where needed when needed? Only if you see to it.

"You engineers," he added, "must be magicians. High commanders properly should assign you appropriate battle tasks well beforehand, permitting you to draw plans deliberately and precisely, so that work may proceed in orderly fashion, somewhat after the manner of construction in civil life. But things do not go that way. The high commander has troubles of his own, following the enemy's doings and evolving plans for employing all troops. Time flies. Actually, his orders to the engineers probably are going to be sketchy; indeed, you may not even be mentioned. The engineer must learn, for himself, the commander's plan, ponder the many possibilities, including upsets by the enemy as well as needs of our own troops, and plan ahead for about every possible contingency. He must use his equipment of course, if possible; if impossible, he must improvise. His science should be working, but it may be anything but exact. The big thing is to do the best possible job and do it in time.

"The demands of the other troops may seem unreasonable to you in many or most cases, but you engineers have a habit of meeting them—which is the foundation of the pride of the Corps of Engineers. You must carry on that high tradition."

There's nothing equivocal about those words. And the young engineers who heard them and got their commissions that day are already on the firing line.

A trainee engineer learns about a transit. In war he may use it to survey camp sites, or lay out a landing field. When he returns he will be trained to build for peace.

Chapter Two

THE TRAINING CENTER

JOHNNY DOUGHBOY, 1943 model, who climbs aboard a train and heads for the engineer replacement training center, is in for three of the most hectic months of his life. There are two of these bustling beehives. One is at Fort Belvoir, Virginia; the other at Fort Leonard Wood, Missouri. Both turn out engineer soldiers by the thousands. The way they come through these systematic war mills is little short of amazing—something like the way Model-T Fords once hummed off the assembly lines in Detroit during the boom days of the twenties. Every three months at Belvoir alone, about 10,000 officers and soldiers are trained, trimmed and hustled off to the front in a foreign theater of action, or to join one of the combat units in training somewhere in the United States.

When Private Jones of Kansas City steps off the train at Alexandria, Virginia, a fifteen-minute bus ride from Fort Belvoir, it dawns on him immediately that he's rubbing shoulders with history. In fact, he touches both past history and the 1943 page which is being clipped off at a dizzy pace. Alexandria is the old stamping ground of distinguished patriots, including the first President, and is one of the oldest cities in the United States. It was a teeming, excited village throughout the Civil War, and is liberally sprinkled with historic landmarks and famous colonial homes. It has a four-lane highway that shoots up to Washington in one direction and goes down through the rolling Virginia hills the other way.

Even though Johnny Doughboy, 1943, is a pretty sturdy character he will probably be somewhat amazed at Washington. It is crammed

with historic monuments, lawmakers, salesmen, government clerks, naval and army officers and more wide streets with gasolineless automobiles than perhaps any other city in America. This Private Johnny Doughboy, USA, headed for Belvoir, has either elected to go there, or has been ticketed for the engineer training center because he had some special aptitude for the job which has to be done by the Army engineers.

As this clear-eyed Army private rolls out of Alexandria in an Army truck or bus for Belvoir, he sees not far from the broad paved highway the wide Potomac River. Across the half mile or more of water he can see busy Bolling Field, the Army air base at Washington. Planes of all types—bombers, fighters, transports—dart in and out of this bustling airfield the full round of the clock. They head for virtually every destination under the sun. From Bolling Field, they carry Army commanders, soldiers, technicians and experts by the score, headed for the different theaters of action around the world. This is the stopping-off place for diplomats and world travelers, consuls and foreign military attaches who drop into Washington by Army plane. Farther up the river he can see the group of structures that make up the Naval Air Station, joined to Bolling Field and just as cosmopolitan and efficient in its magnetic whirl of activity.

As the new engineer soldier climbs down from his conveyance at Belvoir, as it's known to its soldier population, he is again in the midst of a historical setting. Belvoir covers 12,000 acres, beautiful acres interlaced with sparkling streams that flow through Virginia's rolling hills and timber lands. It is one of the Army's busiest educational mills and as modern as any training camp in America.

Just across the reservation's boundary is Mount Vernon, seated on the sidelines watching this strange warfare drama unfold. The new arrival learns that Belvoir accommodates 20,000 enlisted men and officers. The mammoth reservation takes in what was once the Lord Fairfax estate. Fairfax devoted these acres to the art of fox hunting and the peaceful pursuit of agriculture. Across the fields of

These engineer trainees at the Fort Belvoir, Virginia, replacement training center, get a tryout in simulated attack. Here, protected by their own smoke screen, they plunge through barbed-wire entanglements.

what is now Belvoir, George Washington, himself one of the first Army engineers, learned as a youth to use a transit and chain in practical surveying.

The name "Belvoir," meaning "beautiful view," was given to a mansion on the Fairfax estate, which was developed as the heart of a land grant from King James II. Some years prior to the Revolution, George Washington was named agent for the estate. He sold most of the furnishings of the mansion at a public sale and purchased a few of the choice furnishings himself, some of which, it is supposed, are still at Mount Vernon. The mansion was destroyed by fire about 1778 and the remaining brick walls were demolished by British battleships in the War of 1812 when they came up the Potomac River. The preserved ruins now stand about a mile from the post headquarters at Belvoir.

Congress authorized purchase of 1500 acres in 1912 to be used as a rifle range and summer engineer camp for troops then stationed at Washington. An officers' training camp was held there five years later. When the post became Camp Humphreys for World War I, 57,000 men were trained there. It was designated as a permanent post in 1922 and thereby became a fort. It was re-named Fort Belvoir in 1935.

The soldier engineer arrriving at Belvoir today sees a motley collection of weatherbeaten red brick barracks and academic-looking buildings which are classrooms for the famous Engineer School established here for the regular Army some years ago. He also sees a varied array of barracks from the First World War, still standing as a tribute to his predecessor of 1917, but now dressed up with a new coat of paint. Over on the north side of the highway the draftee leaves the World War I reminders and the wide green lawns typical of many old Army posts across America. Here on this side of the road is the systematically laid-out pattern of World War II structures, low wooden quarters, well-ventilated and cleanly kept, which will serve as his classroom, living room, dining room and kitchen.

Training engineers is ever rugged and always as near like actual battle as possible. Here engineers scramble out of a trench, protected by smoke screen, in attack on a barbed-wire entanglement. They take no chances on a surprise gas barrage. Masks are snugly fitted before the rush.

George Washington would be amazed today at the military engineering miracles which they serve them up almost twenty-four hours a day at this war college. He would see strangely draped camouflage nets feathered with oddly colored cloth and weirdly painted canvas. He would probably express some military opinions of his own as he skirted the dome-shaped concrete and steel pill boxes in a flying jeep.

He would watch sweating groups of husky men throwing queer-shaped rubber pontoons into the water. He would undoubtedly stand transfixed while engineers laced the bobbing pontoons into a bridge. It would be interesting to know how he would react a very short time later when a caravan of speeding vehicles loaded with men and guns suddenly swooped down upon the bridge.

Mechanics of this huge training center are so finely spun that a steady stream of engineer trainees is kept flowing. Depending on space available and the speed with which individual training units progress, the orders go out from Belvoir to the various reception centers on the eastern seaboard for selected groups of trainees. Battalions of nearly 1,000 engineer recruits are formed as they come in, battalions of both colored and white troops. The third or fourth day after a battalion unloads at Belvoir, it is completely set to enter the most densely packed training period it will ever know.

Fresh from the reception center, the rookie engineers are all eyes and ears at the busy hum of the place. At the reception center they got uniforms and some personal equipment; they had their physicals; medical officers pronounced them fit for duty—and rugged duty at that!

Very few get through the stiff physical at the reception center with a ticket for Belvoir unless they are sturdy enough to withstand the rough grind in prospect for them. There are many other important niches for the soldier who reaches the Army with slight defects which would handicap the engineer soldier.

At the reception center the rookie was tagged for an engineer because he had some special aptitude for the job. He had, perhaps,

in civilian life been a mechanic, a truck driver, a construction worker, or else he had a combination of experience and academic training which could readily be adapted to the duties of an engineer soldier.

The entire course is scheduled for twelve weeks. Each of these weeks will be packed with forty-four solid hours of training. The first four of the twelve weeks are stamped as basic training. This particular four-week routine is practically the same throughout the Army.

After the arrival of a new battalion it takes three or four days to check classification records and get them in order. During the interim, time does not lag on the rookie's hands. He gets more equipment, including a rifle and bayonet, the first of many types of war tools he'll get to know as well as his own name.

The new engineer soldier is given an escorted tour of the post. The recreation halls and classrooms are pointed out. He learns the location of the chapel, the post exchange and other necessary stopping-off points along the training route. The center's schedule is geared so that a new group arrives and swings into actual training every Monday morning. When the new soldier has been on the post a few days he begins to feel like a veteran as he watches the raw recruits come in.

He may be a little confused at the size of the place at first, but he soon gets to know his way around. He learns that the ERTC is itself organized like a self-contained army. It is organized into a headquarters, headquarters company, motor company, and three engineer training groups.

Each group has its headquarters. The engineer learns that while training he will be assigned to one of ten battalions. As the days pass he begins to realize his part in this giant training mill. He's one soldier in one of ten battalions, but he's also a member of one of the four companies which make up a battalion. As he learns more about Army organization it is explained that he is Private John Doe of a certain platoon which belongs to a specified company of a particular battalion. As he gets into training he also finds that he's

a member of a smaller group—a squad. In breaking down the training units into small groups for closer individual instruction, it becomes easier for the instructor and soldier alike.

A lieutenant, a sergeant with three corporals as assistant instructors, and about sixty trainees make up the training platoon. The platoon remains the primary training unit for the entire period of training.

On his arrival at Belvoir, Private John Doe, slated to become a skilled army engineer and a combat soldier second to none, appreciates the warm welcome. But he quickly discovers that the engineers are demons for efficiency. He sees it in the vast array of facilities spread out before his eyes. He learns at once that the ERTC is as modern as any Army training camp in America. Spread out over nearly 300 acres, the wooden buildings are of mobilization-type construction. The long, low buildings are well ventilated and neatly arranged, and the grounds beautifully landscaped. These modern soldier homes and classrooms are laid out in a convenient pattern so that the engineer can get from classroom to drill field, target ranges, demolitions areas and practice grounds with the least waste of energy and time. What he saves in steps will be spent in the classroom listening to lectures on tactics and other aspects of modern war training.

At once the engineer is made aware of his important mission: he is to become the best engineer and one of the most versatile soldiers in the whole Army. The mission of the ERTC is to supply as many like him as possible to the different branches of the service that never cease calling for more engineers. No war in which American forces have been engaged has demanded so much of its engineers as the present one. Speed is the essence of it, and speed applies to training as well as fighting. Each movement of the soldier is timed and calculated. All along the line each soldier and officer is made to appreciate the vital necessity of scheduling, timing and executing his share of duty in building the Army and getting it to the front.

Chapter Three

HISTORY OF THE CORPS

REVOLUTIONARY WAR records, ragged incomplete documents of the Continental Congress and scattered historical battle references, yellowed with age, contain the earliest known clues to the origin of the Corps of Engineers.

At the outbreak of the Revolution in 1775 young America held few persons acquainted with duties of a military engineer. A few had seen service at Louisburg, Lake George, Ticonderoga, Crown Point and Quebec, gaining limited experience in construction, attack and defense of fortified positions. Aside from these few, there was scarcely any engineering skill or talent in the Continental Army.

Quickly noting this deficiency, Congress, the day before the Battle of Bunker Hill, authorized one Chief Engineer and two assistants "in a separate department." These officers were commissioned in the grades of Colonel and Captain respectively.

In December, 1776, General Washington, who was probably one of the few men in America with professional engineering ideas and skill adaptable to military use, was authorized by Congress "to raise and collect" a Corps of Engineers. Probably Congress was a little skeptical of this new military unit, for it only authorized General Washington to take them on six months' trial, and authorized pay only to cover that period.

By authority of this law it is probable that an organization styled a "Corps of Engineers" was established in the Army. By a Resolution of Congress dated March 11, 1779, a Corps of Engineers was formally established, with Brigadier General Louis du Portail as

Commandant of the new Corps. General du Portail was a distinguished officer of the French Royal Engineers and brought to the Corps the military engineering genius of the French. More than twenty other French engineers followed du Portail to America, and were commissioned in the Continental Army. Personnel of the entire Corps must have included few if any native-born American soldiers. The organization included three companies of sappers and miners. They all served with efficiency and distinction during the Revolution. A number were brevetted by Congress for distinguished services. Names of the Brigadier General, Commandant of the Corps, of six colonels, eight lieutenant colonels, three majors and ten captains are on the record. In November, 1783, the Corps of Engineers was mustered out of the service.

During Washington's administration, conditions in Europe were unsettled. The Colonies were threatened, and Congress authorized the President to fortify certain harbors on the coast. Since there were no engineers in the service at that time, Washington appointed several foreign-born gentlemen, mostly French, a number of whom had served in the Revolutionary War, to direct the work temporarily.

In May, 1794, Congress passed an Act raising a Corps of Artillerists and Engineers for a term of three years. This organization consisted of a regiment of four battalions of four companies each. In April, 1798, a second regiment of three battalions of Artillerists and Engineers was authorized by Congress. Four months later four "teachers of the Arts and Sciences" were authorized to act as instructors for these organizations.

The next historical reference to the engineers is that of an Act of March 16, 1802. This set up a new military establishment. It also authorized the President to organize and establish a Corps of Engineers, separated from Artillerists at this time, to consist of one colonel, one lieutenant colonel, two majors, four captains, four first lieutenants, four second lieutenants and four cadets.

Furthermore, according to the Act, the Corps would be located at

West Point in the State of New York, and the Act provided that a military academy should be included in the Corps. Thus was born the Corps of Engineers and the U.S. Army Military Academy. Since 1812, the Academy has provided officers for all branches of the Army. The superintendence and responsibility for the successful operation of the Military Academy was vested in the Corps of Engineers from its establishment until July, 1866, when the institution passed to the Army at large.

During much of the early period of its organization, duties which now pertain to the Corps were divided between two branches, sometimes under a common head and at other times separately commanded. These two branches were the Corps of Engineers and Corps of Topographical Engineers. Topographical engineers were first provided during the War of 1812. That year Congress authorized, as a part of the General Staff, eight topographical engineers with the rank of Major and eight assistants with the rank of Captain. At the conclusion of peace in 1815 all were mustered out of the service, except two majors.

In April, 1816, however, the Corps was re-established. Three topographical engineers and two assistants (still attached to the General Staff) were provided for each division of the Army. In 1818 the staff assignment was discontinued and these officers were assigned to the Engineer Department and made subject to the orders of the Chief and Commanding Engineer.

The topographical engineers continued in service and the number was gradually enlarged. A Topographical Bureau was established in 1818 under the Chief Engineer in Washington. In 1838 this organization became a separate corps and remained so until 1863. During half a century it was in charge of a vast number of internal improvements, military and civil surveys, and explorations. It was consolidated with the Corps of Engineers in 1863.

During the period from 1802 to 1863, the Corps was charged with much construction work, and was responsible for the building

of fortifications, lighthouses and roads. It also did much improvement on rivers and harbors, as well as carried on important military duties connected with the War of 1812, the Mexican War and the Civil War, and operations of the Army against the untamed Indian tribes.

Staff duties of an especially high order in both the Mexican War and the Civil War were performed by officers of the Corps of Engineers and the Topographical Engineers. These resulted in a large number of brevets for distinguished services. Many of the engineer officers who served with distinction in the Mexican War later became troop commanders of high rank in the Civil War, among them Lee, McClellan, J. E. Johnston, Halleck, Beauregard, Mansfield, Meade and Pope.

After the consolidation of 1863, the Corps of Engineers was increased in July, 1866, to 109 officers. Subsequent increases in the Corps were made by Acts of Congress in 1898, 1901, 1904, 1911 and 1916. The last of these Acts fixed the commissioned strength of the Corps of Engineers at one Chief of Engineers (Brigadier General) and 504 officers.

First reference to any engineer troops in our Army is found in an Act of Congress dated May, 1778, when three companies of sappers and miners were organized. They were scattered among our various fortifications, a considerable portion of the strength being garrisoned at West Point. Between 1783 and 1794 there were no engineers in the service. The Corps of Artillerists and Engineers previously mentioned, which were authorized in 1794, continued in existence until 1802, when it became the Regiment of Artillery, a few officers being detached to form the Corps of Engineers.

In 1812 a company of bombardiers, sappers and miners was authorized by Congress and served throughout the War of 1812 along the Niagara frontier. In 1821 it was abolished, the men being either discharged or transferred to the artillery. From that time until 1846 there was no organization of engineer soldiers in the service.

The engineers become wizards at building dummy objects for practice maneuvers or battle. In battle a squadron of dummy tanks might be built to disperse at several points to fool enemy airmen. In mock warfare dummy tanks may often serve as substitute for big 30-tonners.

In 1846 Congress again established "a company of Engineer Soldiers" which was organized at West Point, and was designated "Company A, Engineers." Since that time it has a continuous history in service. It is presently represented by Company A, First Engineers, whose last home station was given as Fort Du Pont, Delaware.

The company served in the war with Mexico, and in June, 1848, it was returned to West Point. Until the outbreak of the Civil War, the company assisted in the survey of the Northern Pacific Railway. It also accompanied the Utah Expedition in 1858, and assisted in road and bridge building on the Pacific Coast. In January, 1861, the company was ordered to Washington to set up defenses and protect the public buildings, stores and arsenals.

On August 3, 1861, three additional companies were authorized by Congress. This group of four engineer companies (A, B, C and D) was known throughout the Civil War as the "Battalion of Engineer Troops," although it had no authorized battalion organization until after the war. On August 6, 1861, a company of topographical engineers was authorized which later formed the fifth company (E) of the battalion.

Throughout the Civil War the battalion was assigned to duty with the Army of the Potomac. It took part in the Siege of Yorktown, in the battles of Malvern Hill, Antietam, Fredericksburg, Chancellorsville, The Wilderness, Cold Harbor and the Siege of Petersburg. The engineers built fortifications, roads and bridges and performed many other types of construction work especially difficult to accomplish without machinery such as is in use today. In many of the battles the battalion, after completing its engineering duties, was employed as infantry in the line or in support of batteries.

In 1865, the additional company of engineers, authorized in 1861, was enlisted; and in July, 1866, the five companies of engineer troops were formally organized into a battalion. Until the outbreak of the Spanish-American War, this battalion served at the Engineer School and the United States Military Academy. It also performed such

A mock-up tank with dummy to match provide a training object of especial interest to engineer troops. Note the bullet-riddled sides of this "enemy." One energetic engineer has labeled the tank turret with Japanese characters. Real tanks are too valuable to serve as practice targets; therefore, a substitute.

unusual duties as the supression of illicit distilleries near the Brooklyn Navy Yard in December, 1869; did riot duty during the railroad strike of 1877; and assisted at the time of the disastrous Johnstown flood in 1889. The battalion headquarters and most of the troops were at Willet's Point, New York, during this period, with one company at West Point.

When the war with Spain broke in 1898, Companies C and E were organized into a provisional battalion for service in Cuba, Company A went to Manila, and Company B remained at Willet's Point, engaged in the submarine defense of New York harbor. Later, Companies B and E were sent to Manila, where they assisted in repairing roads, relaying railroad tracks and constructing ferries and bridges.

In 1901, Congress increased the number of engineer troops to three battalions of four companies each, and in this reorganization the Old Battalion of Engineers ceased to exist. Companies A, B and E, then in the Philippines, were absorbed by the First Battalion of Engineers. The designation "E" was changed to C, and a new company designated "D" was formed by the transfer of men from the other three companies. The original Companies C and D formed the nucleus for both the Second and Third Battalions in the United States.

With the transfer of its men to the new battalions of engineers, the Old Battalion's name disappeared from the roster of the Army. But the spirit which marked its service in Mexico, in the Army of the Potomac, in the Cuban campaign, in the Philippines and in China still lives and animates its successors.

The newly formed battalions garrisoned the Willet's Point Post, served at Fort Leavenworth, Kansas, at West Point, and Washington, D.C., with periodic tours in the Philippines, where they performed many tasks of real pioneering. The National Defense Act of June 3, 1916, reorganized the engineers into regiments. Three regiments of six companies each were formed from the three battalions of engineers. They participated in the movement of troops to the

Mexican border, and accompanied the punitive expedition to Mexico. Here they performed a great road-building task which permitted the first extensive use of motor trucks by an army for supply purposes.

The Corps' record in the First World War is an outstanding one. During this war, the engineer arm of the Army was expanded from 256 officers and approximately 2,200 enlisted men to 11,175 officers and nearly 285,000 men by November 25, 1918. This included National Guard and National Army units, as well as those of the Regular Army. Many of the units were temporary wartime organizations which were disbanded after the emergency, but which have been retained in many cases as inactive or Reserve units.

During the war approximately 86,000 men in engineer regiments were assigned to various divisions, where they performed invaluable engineering services in support of infantry and artillery. Of these operations, the most important had to do with routes of communication. The once excellent roads of France were worn out after four years of warfare. Our engineers rebuilt and maintained essential roads, built hundreds of bridges, prepared defensive positions, erected obstacles, and performed many other engineering tasks. Much of this work was done close to the front under fire. On many occasions engineers effectively relieved the hard-pressed infantry and took part in offensives. They suffered their share of casualties, and proved themselves to be combat soldiers.

A much greater number of engineers formed a part of the Corps and Army troops which operated behind the front line. Here again routes of communication provided the main task. Corps and Army engineers repaired and maintained light and standard gauge railroads, as well as roads and bridges, and even built new links of railroad. Other important tasks included general construction, map reproduction, water supply, camouflage activities, and operation of searchlights.

Many special types of engineer units were organized for the AEF—such as road, railway, topographical, forestry, camouflage, search-

light, water supply, mechanical and electrical. The railway regiments were among the first to be sent to France, and as early as November 30, 1917, the 11th Engineers (Railway), which was operating with the British Third Army at Cambrai, assisted in meeting the German counterattack in that sector.

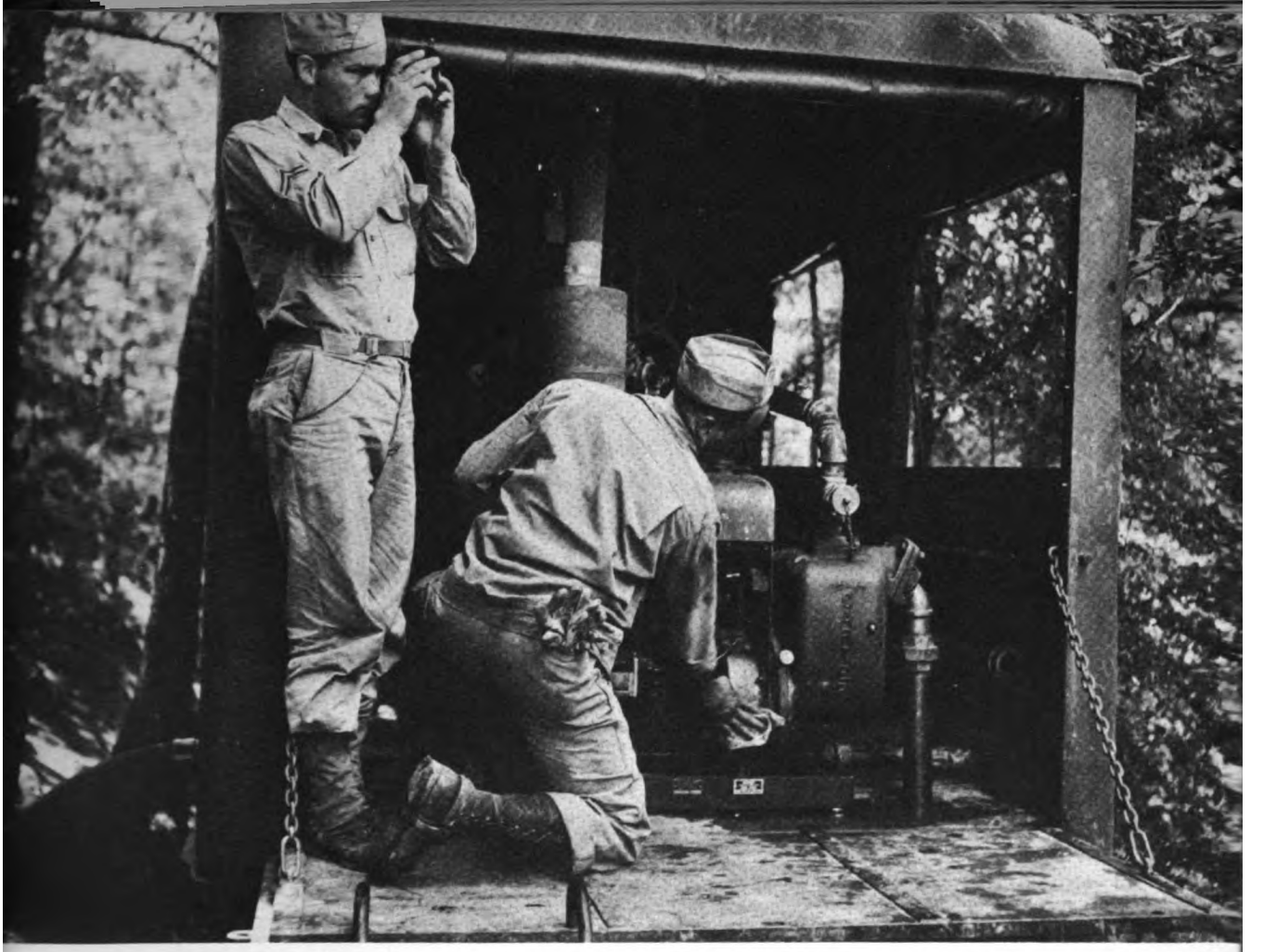
The National Defense Act of 1920 authorized one Chief of Engineers with the rank of Major General, one assistant with the rank of Brigadier General and 600 officers in grades from Colonel to Second Lieutenant inclusive. Subsequent increases were granted the Corps up to 1939, when the officer strength stood at 785; and that brings us to World War II's chapter, which is still being written by the engineers.

The turreted castle is the distinctive insignia of the Corps of Engineers. It was first used during the Revolutionary War and has been used in various forms ever since. Introduced by French officers who were part of our first Corps of Engineers, it was apparently modeled after one of the gates of the city of Verdun in France.

It differs from engineer insignia now in use by any foreign army. The turreted castle serves as a reminder of fortification work, which has been an important task of military engineers from ancient times up to the present.

Engineer colors are scarlet and white. The chief color, scarlet (used both by artillery and engineers) is more prominently displayed. White is used as a piping (edging) or for similar purposes, as on the engineer hat cord and guidon.

The officers of the Corps of Engineers do not wear the button with the coat of arms of the United States which is worn by all other officers. They have a button bearing a device modeled after an early fortification work on Governor's Island in New York harbor. The motto, "Essayons," which is French for "Let us try," also dates back to the time of the Revolution and shows the early influence of the French engineers.



Engineer water supply companies furnish water for all field troops. Here a mobile pumping unit forces water from a stream to tanks where it is purified. The engineer at the left is using a testing device to ascertain whether impurities are present in the water. Careful and expert training is required to equip engineers for this duty. Pure water and ample supply are vital to a fighting team.

The colors (flags) of engineer organizations consist of two silk flags with fringes; one is the flag of the United States and the other that of the engineer organization. The latter is scarlet embroidered with a coat of arms similar to that of the United States, except that the shield and crest of the organization are substituted for those of the United States seal. Streamers with the same distinctive colors of corresponding service ribbons attached to the head of the staff of the engineer organization color, show battle honors (military campaigns) in which the unit has taken part. Many organizations have a coat of arms symbolizing the history of the organization, which in some instances dates back to the Mexican and Civil wars.

Chapter Four

MAKING THE ENGINEER SOLDIER

MINUTES ARE GOLDEN indeed at the training center. The recruit has hardly straightened his foot locker at Belvoir when this methodical rushing process dawns upon him. He has not yet become accustomed to living in five, ten, and fifteen minutes that don't stretch—but he will. To get the men mentally awakened to what is in store for them and to brush off the rough corners, training is started off in short consecutive periods varied throughout the day. Later on, as the soldier-building process progresses, one entire day may be devoted to a single operation, such as bridging a stream or constructing tank traps.

His first week at the replacement center may be somewhat baffling but it at once instills into the engineer the importance of precision in everything he does. Whether it's Monday, Tuesday or Wednesday, the engineer's first full day is crowded with quick-stepping, alert action and ready ears and eyes.

To begin with, the bugler bugles at 5:45 A.M. If he's from the farm, the new engineer fondly recalls that in the country the roosters are just beginning to crow; if he is from the city, he remembers that at 5:45 the milkman would just be leaving the bottles at the door. But when the bugler toots at 5:45 A.M. in the Army, the engineer clears the bunk in one sleepy-eyed Australian crawl. He has heard that if he doesn't get up, sergeants will bring the breakfast to the bunk along with the morning paper. However, he is the rugged type with better judgment and doesn't believe all he hears—so he gets dressed pronto.

Fifteen minutes after the bugler has routed him from blissful sleep, he has struggled into uniform and is standing in ranks. For the next fifteen minutes a noncommissioned officer has watched the progress of a ceremony called "policing up" the barracks, which means tidying up the place. Armed with such weapons as brooms and wastebaskets, they scour the place in a jiffy and leave it as clean as a bride's parlor.

A piping hot breakfast is next on the list at 6:30 on the nose. There is steaming, delicious cereal, he-man coffee, bacon and eggs, and plenty of other items not doled out on a ration card.

After this breakfast fit for a king, the engineer gets half an hour of calisthenics, ending at 7:45. At 8:00 they march into a hall, and until 8:50 watch a training film depicting the fine art of close-order drill. Following the training film is a ten-minute breather. Then out on the drill field in front of the hall the engineers snap into ranks and practice some of the close-order drilling just witnessed.

This goes on for exactly fifty minutes; then comes another of those ten-minute waits. These rest periods are wonderful tonic, except that the uncomfortable sergeant keeps looking at the minute hand on his wrist watch. The sergeant's watch gets to be some sort of gremlin after a time.

When the long ten minutes of rest ends, the line forms on the right for fifty minutes of instruction in military courtesy. During this session the engineer learns why it's not polite to say unkind things to, about, or at a sergeant. He also learns to bring his right arm in an electric swing upward into the proper angle. This is known as saluting, and the engineer quickly comprehends that there are frequent occasions for this act. He may even salute a couple of sergeants before he learns the proper military procedure and how to identify officers from a quick glance.

He discovers, too, that there are many different ways in which the three-letter word "sir" can be applied. During his training in military courtesy the rookie engineer learns that the uniform he wears is a

Thirteen weeks basic training packed with daily workouts over obstacles like this one make muscles, and muscles make sturdy engineers. This is called a toughening up process.

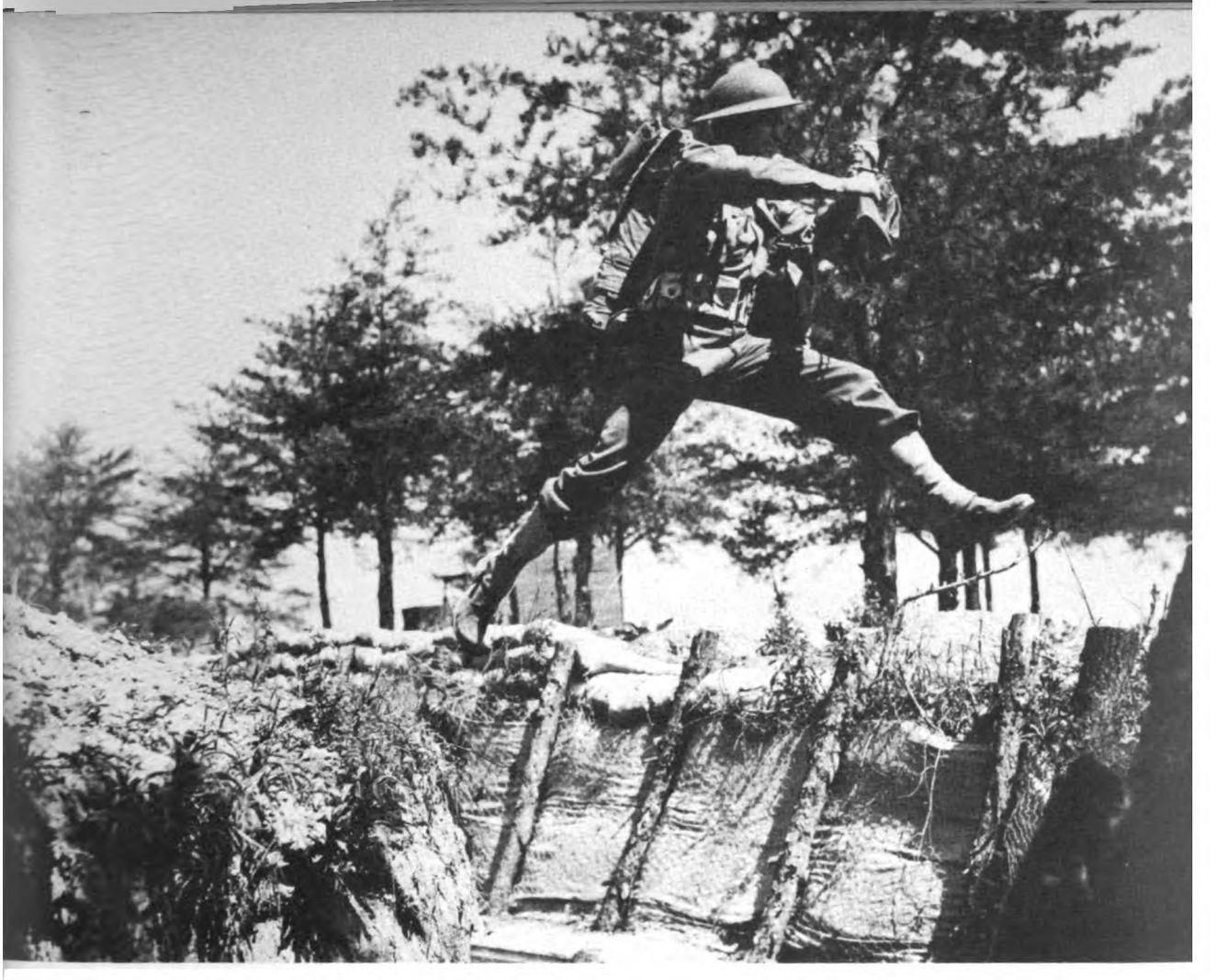
highly respected symbol. It represents something much bigger than his platoon, battalion, the Corps of Engineers, or the whole division. Once through with this short lesson on the gravity of his responsibility as a soldier of the U.S. Army, the young engineer is ready for another ten-minute vacation.

The next forty-five-minute period is important. During this period the Articles of War are read and illustrated on the screen. If the soldier has difficulty in reading big words there still is no excuse for lack of understanding. He sees the Articles of War acted out in classic examples. When this second serious session of instruction reaches the final lap the odor of victuals is wafted in from across the lawn. The mess hall waits with spotless tables and row on row of shining tableware; and during the next forty-five minutes hungry engineers corral some tasty vitamins. They are served tempting, delicious food, ranging all the way from hot dogs to tenderest fried chicken. If the rationing for civilians gets much tougher, the engineers may have to blow up the highways and bridges leading to their training camp to keep out the rush.

All of forty-five minutes is allowed to enjoy this interlude of dinner. Promptly thereafter each soldier picks up his empty plate and files to the receiving end of the dishwashing department. The Kitchen Police take over the clean plates and make them cleaner.

At 12:45 more instruction comes up. This time it lasts until 3:35. It includes the practical everyday technique of soldiering, such as care of equipment, rolling packs, pitching of shelter tents and the display of equipment.

At 2:45 comes an interesting period. It is a course called "Orientation," in which up-to-the-minute news of the world is the text. Latest dispatches from battlefronts around the globe are analyzed and explained. The course is stripped down to facts of military significance, and it is a striking contrast to the training which had been given Axis troops taken into custody by our soldiers in the war zones. According to reports, these enemy soldiers don't even



Obstacle courses designed to toughen every fibre of the engineer's physique are laid out at replacement training center. It is real two-fisted training for actual battle. This engineer demonstrates the method employed to clear a trench without the aid of a flying trapeze.

know Roosevelt was elected the second time, much less the third. Soldiers of the U.S. Army, through this process of orientation, at least get a glance at the world's scoreboard before they come to bat. Orientation serves as an enlightening background for the soldier and undoubtedly adds to his confidence as a fighter.

At the close of the lecture a ten-minute rest is in order. Then comes another forty-five minutes of close-order drill, really a continuation of that close-order lesson the engineers had in the morning.

Retreat is sounded at 5:30, and the engineer has had what feels is enough soldiering in one day to last for a couple of weeks. But meanwhile he recollects that the bugler will uncap another day of it at exactly 5:45 A.M. tomorrow. He realizes, too, that the situation is going to get tougher before it improves, and that he's going to be right in on the show for a period of time which thus far has been described vaguely as the "duration."

As retreat is sounded the flag is lowered. While Old Glory swings gently down, the time for supper is arriving. Then, as one officer explained, "except for occasional administrative duties" the soldier will have the whole evening to do with as he pleases so long as he doesn't get off the post.

The wail of the bugler drops the curtain on both festivities and study at 11:00 P.M., followed by a bed check to see that all are tucked in and courting Morpheus.

On certain nights during the week, but chiefly on weekends, music flows from the recreation halls, accented by the shuffle of feet and the swish of skirts. These dances, set up by the recreation or morale officers, with the co-operation of the USO and other outside groups, are greeted with enthusiasm. The latest motion pictures are shown on the post nightly. Frequently big network radio shows featuring stars of stage and screen originate programs from the recreation halls of the post. They are welcome diversions from the strenuous grind.

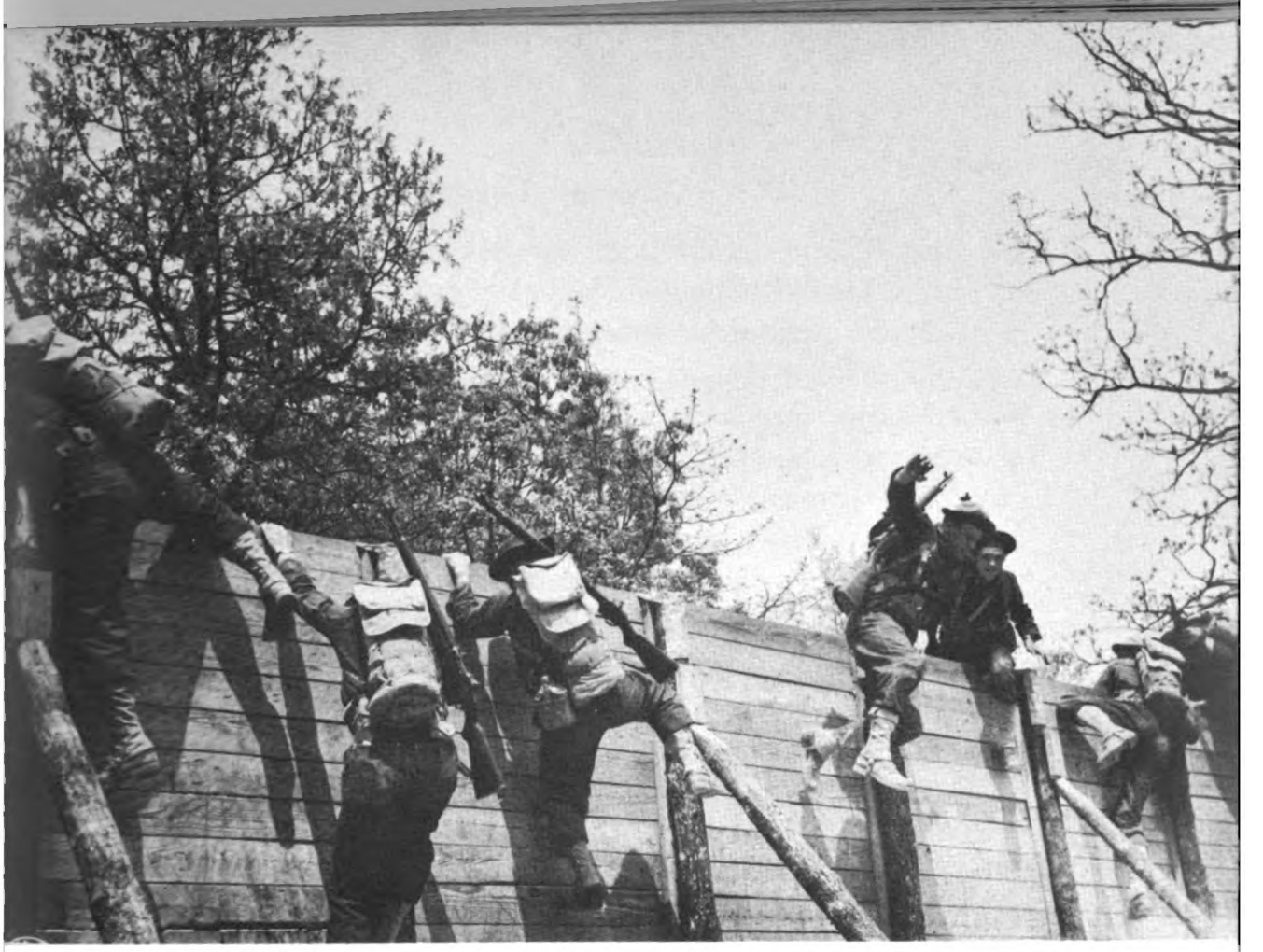
The recreation halls are well stocked with lounges, soft chairs,

Engineers at the replacement training center learn to use bayonets as well as the mechanical tools. They are taught to drop engineer tools instantly and fight with infantry or any other arm to which they may be assigned. Here they simulate an attack along a ridge.

books, magazines, and game tables. Table tennis, dominoes, checkers and other indoor sports are always on tap during the evening hours for the engineer who is so bright he doesn't have to spend them pouring over academic versions of field problems.

Occasionally he may get a weekend pass good for twenty-four hours. Since Washington is only half an hour away, and packed to the rafters with many attractive government girls and patriotic social and civic and club leaders who tumble head over heels to entertain the soldier, he is in no need of sympathy. The USO, the various service men's canteens and a host of other special activities are always on the calendar in Washington, whatever the day of the week or the hour of the day or night. Sight-seeing tours, dances, movies, stage shows, horseback riding, golf, tennis, boating, and almost every other imaginable brand of recreation can be his for the asking.

One of the first books the engineer comes across at the ERTC is the engineer soldier's handbook. This little pamphlet is blunt, to put it mildly. On page two it says, "Frequently, you will have to fight in order to carry out your duties." It tells the engineer right off that he's here for business—war business. "You will lay mine fields on the flanks or in front of our infantry to stop enemy tanks," it says. "You will assist our attacks by clearing paths through enemy mine fields or assaulting fortifications. Even while working in rear areas, you may be subject to sudden attacks by swiftly moving enemy tanks and airplanes, or by infantry carried in trucks or dropped by parachute. Engineer soldiers must frequently work in small groups on independent tasks under direction of their noncommissioned officers. The success of these missions will often depend upon your own engineer skill, knowledge, initiative and resourcefulness. Lack of these qualities may cause the loss of your life and the lives of many of your companions," the cheerful little book adds. "Your new job as an engineer is a difficult one. It is harder than the tasks of engineer soldiers in our past wars, but by learning well what is taught you and by careful attention to duty you can and will prepare yourself, as



Loaded with full pack these engineers take another hurdle of the obstacle course. Getting over this wall with full pack and rifle is about as easy as leading a mule through a revolving door. With so many seconds allowed to negotiate each hurdle the engineers quickly catch the spirit of the training and turn it into a sport.

they did, to accomplish the job with credit and honor to yourself and to the Corps of Engineers."

As he moves through training during the next eleven weeks, the engineer will find frequent occasion to study this little engineer primer. Aside from its unglamorous pictures of such items as picks, shovels, cross-cut saws, carpenters' tools, explosives, knots and hitches, the handbook tells the soldier he has a long tradition to back him up.

On page one the engineer primer informs the recruit that engineers have fought in all the wars of the United States and have established an enviable record of service, both in war and in peace, which may well "be a source of pride to you and every other soldier of the Corps." It adds, "This tradition covers service to the country of many widely different kinds. It has included hard fighting and hard work and indicates the type of the future service which you can render and the kind of record which you should strive to leave behind you. Now, more than ever, must the engineer be able to take part in combat as well as perform the many kinds of both rough and skilled engineer work needed to assist the other arms to win success in battle.

"The task of the engineer has been modified and made harder by the increased use in war of airplanes, motor trucks and tanks. Their use has increased the speed of movement in war so that you must now build and repair, or destroy, bridges and roads faster than ever before.

"To carry the increased weights of trucks and tanks, roads and bridges must be stronger and heavier. Landing fields require much difficult and carefully executed engineer work.

"Protection against enemy tank and air attacks and rapid repair of damage resulting from them require the services of engineers over the entire theater of operations from front lines to rear areas. To speed your work, many new portable power tools have been developed which you must learn to use. Your work will be aided by

the use of trucks which will transport you with your tools and materials as near the front line as enemy fire will permit. Nevertheless, you must always be able to march and fight on foot and still have strength left over to do your engineer job," this textbook in global war admonishes.

The brilliant system of instruction at the training center packs these lessons home with amazing dexterity. Boys who had to work hard to get through the eighth grade learn in a short time, by the engineer teaching methods, to dismantle a machine gun blindfolded. And a machine gun's intricate mechanism would stump a highly trained watchmaker at the first attempt to put one together.

For instance, to learn the use of explosives in "Demolitions" the engineer gets seven lessons, each of four hours' duration. In each lesson he learns a new step. First he may get four hours in the proper method of applying a detonating cap to a charge of dynamite. And his last lesson in explosives, if he has listened closely, and is still a soldier in one good solid piece, may be the demolition of a steel bridge.

Thick skulls are no obstacle to the instructors at the training center. There is a softening-up process now in vogue here that makes war training easier than finding a seat on a bus in Washington, D.C.

The engineer soldier can indeed say with some pride that tough as the educational process is, the Army certainly takes to the modern methods. The embryo engineer sees, studies and practices his problems by the process called Visual Education. It saves countless tempers and gives longer life to many an officer's vocal cords. Anything from a sequence showing the correct shoe-shining posture to the maneuver of an entire division can be taught by the use of film, thereby shortening the training time which might otherwise be necessary. The average soldier no doubt also saves considerable amounts of skin in training by this method.

For example, the engineer has already been tipped off that he will one day meet a metal monster called a tank. When he does,

it's no time for dawdling. He has to act, and act quickly, and still retain his composure.

One bright morning he marches to the hall where these training films are the show of the week. Lights go out and the feature flashes on the screen. There is no Mickey Mouse, no Donald Duck. No advertisements, or previews of next week's Roy Rodgers, Bing Crosby or Dorothy Lamour thriller.

The hero flashes on the screen immediately. In this instance, however, the hero is a villain—a giant thirty-ton tank! It roars and rumbles, swishes and turns. Occasionally one of its turret guns lets go with a mighty blast. The engineers watch with animated wonder as the steel charger races across a field and into a clump of trees. On through the underbrush it plows, snorting and panting, and comes out on the opposite side. Just beyond, a line of foot soldiers is spread out along the rim of a knoll in defensive positions. They cannot escape the tank's charge. They have to stand and take it. The tank rushes right on into the ground defenses, its guns roaring.

The engineers are all eyes and ears now. They watch eagerly as the soldiers defending the knoll duck into trenches.

The tank rushes squarely over the trenches and foxholes spread out over the area. Huddled flat at the bottom of these foxholes and trenches, the soldiers are now safe. The tank passes on through and beyond the defensive position of the ground troops. No one is injured. This is only a practice lesson in war. These soldiers had been instructed not to run, climb a tree or make a confused dash for shelter. Meanwhile, an instructor's voice on the screen has been booming at his audience, explaining the tactics of tanks and the methods of self-preservation in the face of such an attack.

The show ends. The lights go on. The engineers march out of the hall. An hour later they are out on the field. The engineers have been told to scatter themselves over a practice area. Foxholes may have already been dug, or the engineers may be given short regulation shovels and told that they have just so many minutes to carve a hole in the ground—like digging for your life.

As easy as falling off a log! This is one more tricky obstacle of the course which makes the engineer soldier one of the most rugged in uniform. During basic training frequent trips through this course encourage deep breathing and induce fagged biceps. Sense of equilibrium gets tryout too.

The engineers get set by a watch like a string of high hurdlers at a track meet. The signal is given and a tank roars and rumbles onto this natural stage of comparatively level stretch of ground. The tank starts chasing these engineers like scared rabbits. One engineer stumbles and plunges headlong over on his nose, takes a couple of somersaults and waits for the thirty tons of steel to roll over him and end his war career.

But the tank slackens speed and turns, darting after another engineer closer to a foxhole. This engineer dives for the hole and rubs his nose in the dirt. He's breathing hard and heavy, for the tank is about forty feet behind. On comes the tank like a switch engine on a flying switch. The big tank rumbles on over the foxhole and swings after another engineer who is getting a kick out of the show.

The engineer down in the foxhole over which the tank has just passed peers over the rim of the hole. He's unhurt, but probably a little scared. He's no longer afraid of a tank. He knows what to do, in case. Meanwhile the tank wheels, darts, spins and roars after the engineers until most of them are hugging dirt in their craters, trenches or foxholes.

The instructor signals the tank driver to bring the tank into home base and the game is over. It is a lesson well learned. The demonstration on the screen was a perfect lesson. That is the only way the films are made. Each lesson in warfare is flawless on the screen, and it's easier to repeat the performance once the correct method is shown. This has been only an example of the technique in one probable battle action. Many others are carried out in the same manner at the training center with exacting patience and thoroughness.

In all instances the engineers see their handiwork on the field put into actual use. When they have completed an assignment, such as the building of a pontoon bridge, a raft or a tank trap, they see it immediately descended on by a caravan of mobile equipment which will use it or try to demolish it under conditions approximating those of actual battle.

Obstacle courses have become familiar sights to nearly all our armed services who fight on land. To the trainee engineer such vertical walls as this seem insurmountable at first. In a few weeks he skims over such a wall in a matter of seconds.

In Chapter Six, "Tank Trappers," this technique, which is only one phase of the training, is illustrated. As the twelve-week training period draws to a close the men are transferred, in some instances as units, and in others as individuals, to regiments in training at other stations. Some may be transferred to task forces overseas.

As one group of a thousand men moves on, another arrives to take its place; and the process is repeated at a feverish pace, week after week. While the engineer has studied and worked at Belvoir and at Fort Leonard Wood, Missouri, he has been thoroughly toughened physically, but he is not a completely trained soldier. He still has to learn to move with and be a part of the team of the larger army organization. He must also learn to co-operate and work with many diversified types of regiments with which the engineer operates in combat.

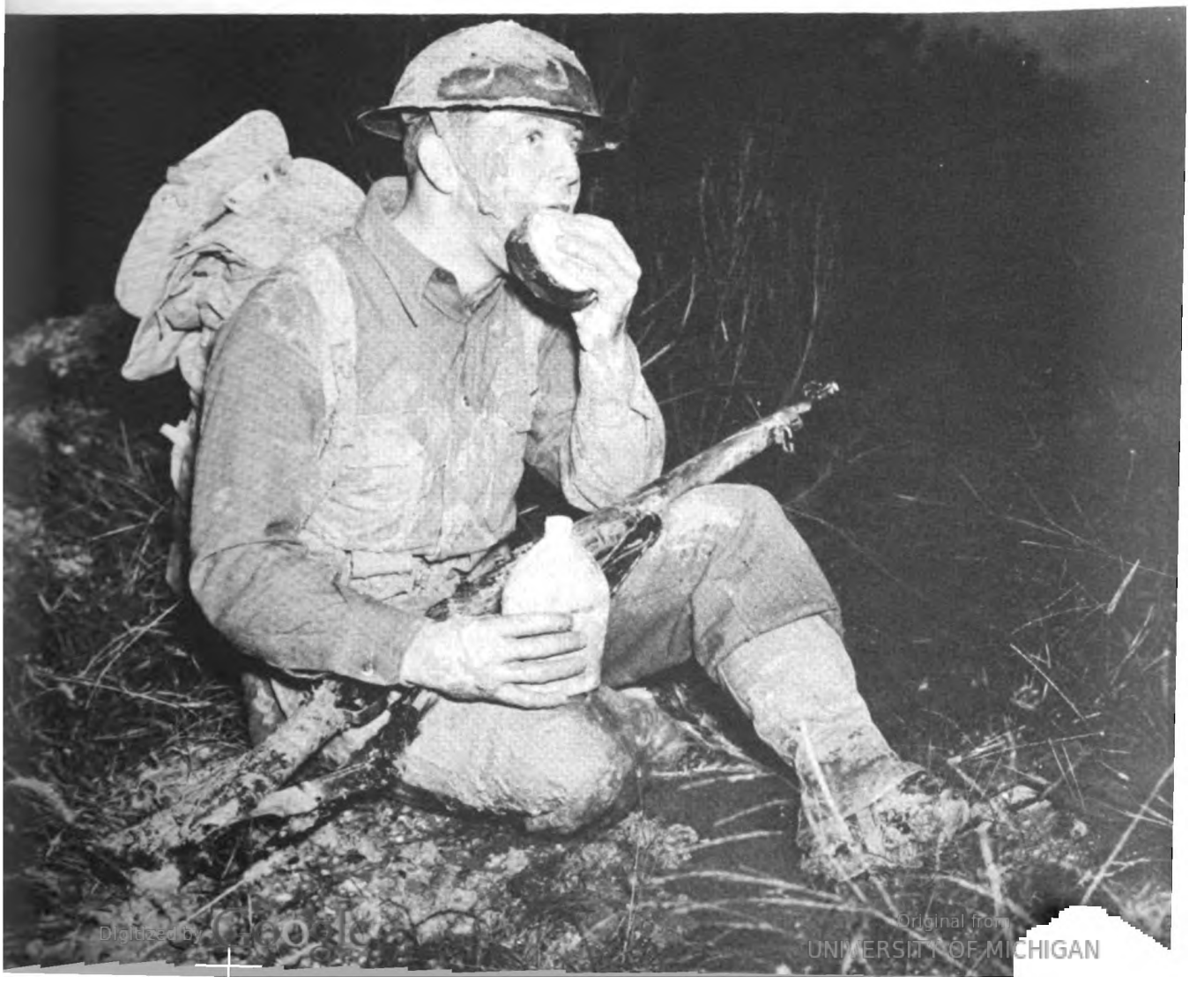
The training program designed to cover three months at Belvoir and its twin center at Fort Leonard Wood is shortened and condensed at every turn. The demand for specialists from the Corps of Engineers has risen so sharply in recent months that about forty per cent of the class is usually transferred at the end of five weeks. They are sent to one of the trade schools, colleges or universities around the country which have agreements with the War Department to provide certain types of advanced training. Men selected for this specialized training are picked for their special aptitudes or previous civilian experience.

A considerable number of the trainee engineers are also drawn from the classes in progress and assigned to one of the specialists schools at the training center which are operated outside of the curriculum of the regular twelve-week training period.

There are several of these schools at Belvoir. Their curriculum in some instances is highly technical and requires a better than average education. Among the courses are those in handling of water purification equipment, map reproduction, and photo-topographical processes, all vitally essential to the Army.

A large number of the trainees are also drawn from regular classes upon the expiration of the seventh week of training and immediately sent to special schools at Belvoir to learn truck driving, and how to handle heavy bulldozers, cranes and other construction equipment. Some are assigned to specialize in carpentry; others learn to be mess sergeants, bakers, cooks and clerks. Such is the complicated structure of the Army fighter mill.

This trainee engineer sits one out. Wet, mud-caked and probably a little weary, he is getting the finishing touch to realistic battle training under conditions that fit him for the real test.



Clearing a path through barbed-wire entanglements for supporting troops. Here engineers use wire cutters. They can, and often do, use Bangalore torpedoes for the same purpose. The torpedo explodes, severs wire, and rips a cleaner path.

Chapter Five

OFFICER CANDIDATE SCHOOL

A "SKIN SHEET" ISN'T A sheet of skin. It's a sheet of paper. On it are marks. The marks are called demerits—just like those the engineer officer candidate got in school back in Little Falls or Omaha. When he got a certain number of those back in Little Falls or Omaha—well, teacher dropped around one evening and had a chat with his mother and father. Something had to be done about Willie. He just wasn't showing up in school the way he should. Wasn't anything wrong with him—he was just inattentive. Liked to shoot paper wads with a rubber band, or perhaps dangle the tip of Susie's curls in the inkwell.

Now Willie is a soldier. He's an officer candidate, soon to be a second lieutenant with a gold bar on his shoulder, and will belong to the Corps of Engineers. The skin sheet is his record kept by the instructor. Willie, who by now is perhaps Sergeant Bill Jones to his fellow officer candidates, probably won't be washed out of the school, but if he does happen to get too many demerits he may be called on the carpet in the military manner.

Typical offenses which bring these marks are:

Officer of day not familiar with procedure of dismissing company under arms: 1 demerit.

Ash tray concealed under blanket: 1 demerit.

Shoes under bed improperly shined: 1 demerit.

Gazing out of window while at attention: 2 demerits.

This demerit system is the yardstick by which instructors keep a check on military neatness and conformation to Army regulations.

According to the records, Major William Whipple, Jr. says that ten demerits is the top given any officer candidate thus far. The soldier unintentionally made an incorrect statement in an official report to his superior officer.

Major Whipple, of the Corps of Engineers, is a brilliant teacher and swings the baton over the school system at Fort Belvoir, Virginia, although the Candidate school is a part of the Engineer School at Belvoir headed by Brigadier General R. C. Crawford.

If the Willow Run bomber plant at Detroit is making bombers faster than the Engineer Officer Candidate School is turning out officers, heaven help the Axis! They are training soldiers here who know how to lead soldiers. They are making officers out of enlisted men who want to be officers, and they are giving them a brand of military training that sticks.

Any engineer soldier with the inclination and a head full of good common sense can become a first-rate second lieutenant here if he has some initiative, a good physique, and is aggressive enough to take the medicine. Minimum entrance requirements are that the candidate be between 18 and 45 years of age. He must have been in the service at least three months. He must have passed his general classification test with a rating of 110 or over. He does not have to be a noncommissioned officer, but he does have to be recommended by his commanding officer on the basis of demonstrated leadership ability.

Leadership, the instructors at Belvoir logically point out, doesn't come out always with a sergeant's or corporal's stripes. There are plenty of privates who eventually make excellent leaders, and records are plentiful that show this. There is one other "must." The potential officer candidate must pass a rigid physical examination. There is no minimum educational requirement on record; it is as simple as that. Many excellent candidates never applied for training at the school in the beginning because they felt that it required an engineering college graduate or a licensed engineer to make the

grade. Of course the Army would rather have it that way, but enough such men are not available. Therefore the Engineer School goes to work on the raw material, and out comes an engineer. There hasn't been any kickback yet! And many an engineer officer from this school is now leading his men where the shells are dropping with uncomfortable regularity.

The instructors at the Officer Candidate School say that a high school graduate with half a year of algebra can get over the entrance hurdle if he has the other attributes. Records at the school show that several candidates went sailing through the course with only a couple of years of high school training. But these were men with high-grade native intelligence. Age has one advantage at the school. Men who are over 29 years of age, and qualified, are kept in the school for more training and are commissioned as first lieutenants or higher.

These future officers cover fifty or more subjects in the thirteen weeks—everything from floating bridges to night marches and bivouacs.

If a soldier has had some training in one or another of the subjects he is lucky. No previous experience or study of a subject is taken for granted, however. And the pace is almost at machine-gun tempo. It takes a good deal of concentration to win that gold bar in this officer school. Once into the grind, there is little relaxation. Reveille is at 6:00 A.M., and every candidate is busy every minute until 4:50 P.M. More than half the work is of the "get-your-hands-dirty" type—practical solutions to real problems, such as taking apart and reassembling machine guns, or setting up tank obstacles, or rigging.

This training school gives one of the toughest courses to be met anywhere in the Army. After the evening meal, there is a supervised study period from 7:00 to 9:00 P.M., and this goes on for five nights a week. This period of supervised study is where many of the knotty administrative problems get untied. The officer instructor then has time to get around to the different men at their desks and pass out

some individual tips and hints on how this or that is done, and what makes wheels go round.

"The basic qualities required in an officer," Major Whipple says, "are a sound physique, the necessary military knowledge, courage, a strong will, natural intelligence, and other qualities of character and personality which command the respect of men."

Selection of candidates for commissions is based partly on their academic standings, and partly on their leadership qualities. The Officer Candidate School uses an exacting yardstick to measure the characteristics of its men. Candidates are rated in leadership according to intelligence, initiative, force, judgment, handling of men, physical activity, endurance and bearing. The rating also includes judgment of a man's neatness, co-operative spirit, personality, loyalty and general suitability. The average measure of the thirteen items listed is considered the general rating in leadership.

They have their own ways of testing a man's "leadership" qualities. They don't just say, "Now, there's Private Barnes from Louisville. He'd make a fine officer. He stands like a West Pointer, and he's smart as a whip." They don't take anything for granted. Although the candidate is never quite sure of it, the instructors pry into the student's make-up with a psychological can-opener. They listen to the tone of his voice when he says, "Yes, sir!" They observe the way he walks, talks, listens, laughs, jokes, eats, studies and sleeps; and they see how he gets along with his fellow candidates and how he discharges the little methodical responsibilities they systematically pin on him. The instructors have a scientific way of prodding, cajoling, aggravating and psychologically pin-pricking a candidate to see how he reacts. The resulting score they add up on the record, take the average, and by some mysterious military mathematical procedure, are amazingly accurate in judging a man's ability to perform the duties of an officer.

Students in the Officer Candidate School are organized along the same lines as in the training center. The unit of instruction is

These engineers are worming their way under barbed wire to plant dynamite. Here dynamite supplants wire cutters. Once path is open troops can rush through behind engineers.

the platoon, somewhat smaller in actual number of men than in the enlisted men's training schedule. Platoons are grouped into companies, companies into battalions, and battalions into regiments. Officers designated as tactical officers command each platoon, handle administration and some types of instruction, and watch the individual men closely throughout the course. The platoon commander's ability to keep an eye on several individuals at a time enables him to judge accurately the qualities which have to be developed and credited to the candidate.

However, the exacting check on the officer student is only a continuation of the vigil kept from the day he was inducted. Since all officer candidates are selected from the ranks of enlisted men, each one is observed from the day he is inducted into the Army. Notation is made of his educational and practical experience, and he is given every opportunity to display qualifications necessary to become an officer. He was pretty thoroughly gone over before he ever arrived for officer candidate training. He had to appear before a board of officers on completion of his first three months of basic training. The board examined his educational record, experience, character and physical condition, and had a look at his qualities adaptable to officer training.

The platoon leaders are rotated frequently to do away with any possibility of partiality. This is an objective method of cold, calculated evaluation. The platoon leader often eats with his men. He attends all practical problems in the field with them. The men get all kinds of tests in practice. A candidate may be required to lead a group of men through intricate close order and extended drill. In another test he will be made officer of the day.

During this 24-hour period he is responsible for sounding of calls, supervision of class formations, and other routine duties of command. On other days he will be placed in charge of a platoon, or a company, in the actual construction of a bridge, or he may be told to lead a company through the regular period of calisthenics for the day. He will get from two to six of these leadership assignments each month.

The men who show up poorly get more. In order that he may be able properly to instruct his men later, the student is told one day to hop to his feet and give the platoon a lecture on some phase of engineer work.

The instructors at the school have developed what they call the forty-hour test, which is the climax of the training period. During these forty hours they subject the student to all types of stress for endurance and quick, cool decisions. The test usually begins on Thursday evening after a full day's work. On the schedule that night is a move by motor truck, two tactical marches and two bivouacs, with security problems thrown in. The security problems are those which show whether the students know how and where to pitch camp, and how to protect it with camouflage and so on, after they're on the ground.

During the night there are all kinds of premeditated troubles tossed into the ranks of the officer candidates. For instance, the water-supply truck lags far behind and breaks down. The men bivouac, throw up shelters and everybody is starved for a drink of water. The truck broke down because some officer deliberately screwed down the carburetor inlet and shut off the gas from the motor. Another instructor steals a box of hand tools and a platoon struggles to get a shelter up without so much as a tent stake. This goes on and on. But every man during the forty-hour test tries to control his temper and show no signs of irritability or nervousness.

The next morning they plunge right into patrolling and scouting, and perhaps in the afternoon go through extended order drill. On Friday night comes another bivouac with security problem, a combat problem and a non-tactical march. When all through with this, they clean their rifles and bayonets in the middle of the night. This hustle and bustle, marching, cleaning, bivouacing, and loading, unloading, and reloading of equipment has been going on since Thursday evening and it is now the middle of Friday night. No sleep yet. Then Saturday morning comes inspection, more drills and bayonet practice. Sometime during Saturday a few of the men catch three

or four hours sleep. But most of them are as eager as the officer instructor to find out how long they can go, and they keep right on plugging. When this test ends on Saturday there's a tired, exhausted crew of engineers in the making. Those who fall out or show extreme fatigue are noted and their future duty with troops in the field will be questioned until the reason is unearthed.

"Certain men are much easier to grade in leadership than others," says Major Whipple. "Some types, both strong and weak, are easily classified almost at first acquaintance. The talkative, aggressive types quickly identify themselves either as natural leaders or as braggarts without judgment. Most of the very good leaders of mature development are readily picked out, as well as the candidates who lack both physical and mental development. The physically immature, the physically weak, the timid, the effeminate, and the prematurely aged are usually apparent to early observation, and study of records.

"The largest group which is difficult to judge is comprised of those who are generally quiet and unaggressive, whose appearance does not indicate any particular type of mentality or personality, who are reasonably competent individually, and who are lacking in any outstanding physical characteristics.

"These men are hard to judge, among other reasons, because they are hard to distinguish and to remember, although they include diverse types and abilities. They include some fine mentalities, some strong personalities, and a large number of reliable leaders, but also a considerable percentage of men either utterly lacking in force, imagination, and initiative, or psychologically unfit, who escape early detection, mainly by neat appearance, conformity to instructions, and reasonable dexterity at drill.

"Another type difficult to evaluate is the small, unprepossessing individual. He has a quick mind but is obviously high-strung. This man may be weak, nervous and easily rattled, or he may have a keen mind and strong will, which make him a reasonably good leader despite his appearance.

Here an engineer operates an earth auger digging holes for telephone poles. Though most engineer operations are made easier and speedier by mobile equipment such as this, he nevertheless becomes intimately acquainted with pick and shovel, the mainstay of the engineer in World War One.

"For opposite reasons, the large, confident, well-fleshed man may be hard to judge. His complacency may be due to ignorance and not to accomplishments, and his large, firm features may conceal a weak and indolent character.

"A final category difficult to judge fairly is the pronounced racial type, which presents difficult puzzles to one not familiar with that particular race. Individuals of various racial backgrounds but similar potentialities look and act differently. Each case must be judged on its own merits. There must be no racial prejudice in the selection of officers."

These engineer officers at Belvoir and at the Officer Candidate School at Fort Leonard Wood in Missouri do not "wash out" a candidate who doesn't make the grade at the first try. They have what are called "development classes." If the candidate can't keep the pace, but still has the makings of an officer, they put him in one of these classes and add a few extra weeks to his training to give him a chance.

The officer candidate course includes 622 solid hours of instruction. And the fifty or more subjects they cover are not easy going. Every one requires that the soldier apply thinking and sound action. For instance, the candidate gets 10 hours training in Camouflage, 12 in Obstacles, 20 in Explosives and Demolitions, 20 in Map Reading, 10 in Military Law, 28 in Administration, and 6 in Signal Communications, to mention only a few.

In addition, the mistakes made by troops in the battle zones are tabulated, rushed back to Washington, and then funneled down through the various commands to the Officer Schools.

In the Tunisian campaign, for example, our troops performed well, but they did make mistakes. Lieutenant General L. J. McNair, commander of Army Ground Forces, issued a memorandum to all troop commanders of units training in the United States. "The solution," he explained, "is the inculcation of such a state of discipline that men will, in the excitement of battle, instinctively do the things which they have been taught to do in the classroom, on the drill

A trainee engineer at work with an earth auger. Later he will use the auger to drill holes in roadbed to insert explosives. Too, this handy tool drills holes to accommodate Signal Corps linemen setting poles to carry telephone wires.

field and on maneuvers." In the memorandum McNair listed the following as faults observed in the Tunisian fighting:

(1) Failure to dig foxholes promptly upon taking up a position.

(2) Failure to make full use of available cover and to conceal their position by improvising camouflage quickly.

(3) Avoidance of booby traps—equipment of personal belongings, such as fountain pens, left behind by a retreating enemy, which explode when souvenir-hunting soldiers pick them up.

(4) Insufficient dispersion of troops—an important feature to lessen the effective of enemy bombing.

(5) Movement of truck columns bearing supplies or troops in closed-up formations and during the daytime, making them good targets for enemy air attacks. Such movements should be made at night when possible.

(6) Failure to make a proper reconnaissance of the route over which motor columns are sent.

In his memorandum McNair said, "In general, personal leadership by commanders has been of the highest order and there have been many examples of the personal bravery of officers and non-commissioned officers inspiring their men to superhuman efforts."

There are a number of varied methods of instruction used throughout the course. Training films prepared by the War Department cover many subjects; many film strips are also used in illustrated lectures. In all instances the visual instruction supplements that of practical experience in the field. In addition, there is a library on the post with about 70,000 volumes. It is one of the most complete military libraries in existence. Facilities of the Engineer School also include a field printing plant, a photographic laboratory, a lithograph shop and a photo-engraving plant. These facilities are all in constant use by the officer candidates, and they learn fast.

The soldier with a strong back but not much mental equipment, once perhaps considered sufficient to his task, is no longer in vogue. The tremendous speed at which military operations over large areas are carried out demand that every man and every officer be trained to exercise his own individual initiative, as well as to co-operate with the team.

Paratroops and armored columns, which may slash at the fighting forces from the rear and far behind the lines, leave no soldier out of the war. He has to be able to fight, whether he makes maps or pilots a bulldozer. And it's for fighting that the engineers are trained.

Chapter Six

TANK TRAPPERS

DOWN THE ROAD ABOUT 150 yards a giant thirty-ton mass of steel shudders, roars and snorts. It is known as an M-3 tank. Streaks of fire and smoke belch from the exhaust. The husky red-faced driver, his big, padded helmet strapped tight, peers through goggles toward the barrier. He guns the motor waiting for the "go" sign. Twigs high up in the trees lining the narrow, wooded lane tremble at each roar of the fire-eating dreadnaught. Huddled near a cleverly stacked pile of rough logs cut from surrounding timber is a platoon or two of engineers. They're waiting nervously for the big moment. In a second or two the officer will give the signal and at more than thirty miles an hour the thirty-ton cargo of sudden death will thunder down the stretch and plunge into the "tank obstacle."

The captain flashes the signal. The big raw-boned sergeant tank pilot catches the sign and eases the throttle down. The motor growls and roars. The exhaust spits fire and smoke and the giant land battleship is on its way. It gains momentum rapidly and swings up to the barrier.

The tank driver had carefully surveyed the obstacle before he let his monster steed have the rein. He thinks he's going over the top and consequently will send the jubilant engineer crew's spirit down to zero. But he's in for disappointment.

His steel charger plunges into that stack of logs. Loose stones scattered in front of the obstacle strike sparks from the steel tread as the tank claws at the solidly built barrier. The speed of the on-

rushing tank is halted in about five seconds. Logs creak and groan and the tank rears skyward like a bucking broncho. Finally at the top of the barrier the motor coughs and spits. On the pinnacle of the obstacle the tank hovers like an impaled monster.

Wild shouts of glee and blood-curdling yells rend the surrounding woods. The engineers have done it again. They have stopped the tank cold. The tank killers rush to the obstacle. They hurriedly unlatch the tank's cover and lift the driver out of the dead "sardine can," the none too affectionate title coined by the engineers for tanks.

The driver is pretty badly shaken up but not seriously injured. The engineers give him a hand in massaging the untidy bump on his forehead, and he will live to pilot another tank into a trap. The driver takes no little pride in this dangerous job. He's a volunteer at the task and he knows it takes plenty of stamina to ride one of those steel chargers head-on into a barrier that knocks the daylights out of a thirty-ton steel mass of strongest plated metal.

Had the tank been an enemy, heavy armor-piercing shells, mines or a sizable shot of TNT would have blown him sky high. Impaled on the top of the obstacle, he would have been the target for all the stuff the engineers could have poured into him.

This sort of drama is a daily event at Fort Belvoir, and at other training centers located at strategic points around the country. Tank stopping is a specialized course, packed with stretches of the hardest work in the Army, flavored with excitement and plenty of thrills. It's serious and deadly business from start to finish. The men chosen for this lot are huskies. They have to be tough to hack down timbers and lug the big logs, which may be twenty feet in length and perhaps two feet or more in diameter.

A platoon of forty engineers, in exactly ninety minutes from scratch, throw up one of these formidable barriers. The trap itself is usually a pyramided stack of logs perhaps six feet high when completed. Huge, sharpened piling cut from the surrounding woods go

Tank Traps like this one provide headaches for the Armored Force. Engineers specialize in the art of stopping these metal monsters and they can build an improvised trap like this in little more than an hour. Once off balance or overturned, a tank becomes a ready target.

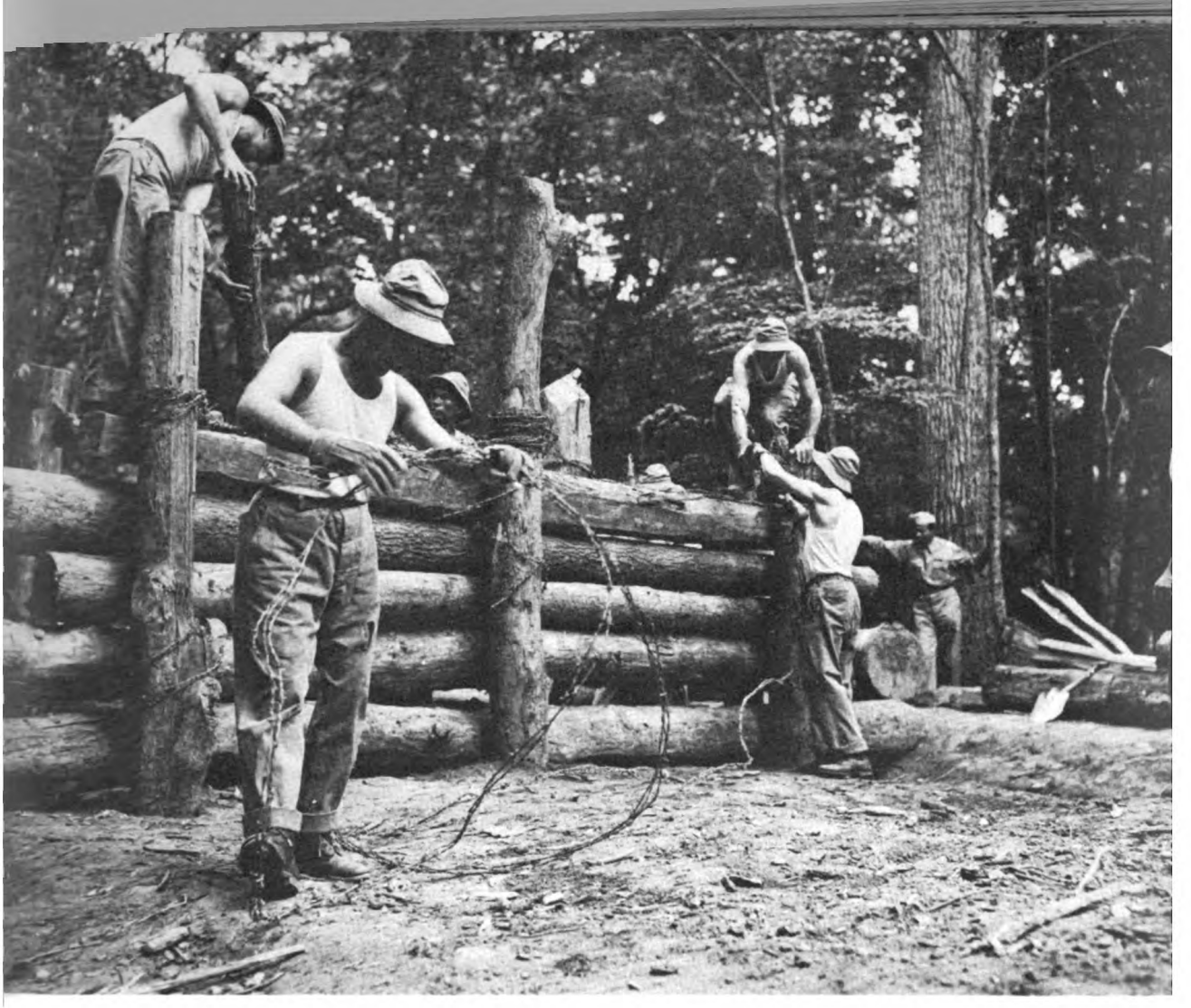
to make the foundation. The logs are driven deeply into the ground, then other logs are skillfully wedged against the vertical piling. Into the framework the engineers pile dirt and odd chunks of logs to make the obstacle solid. The mounting of dirt and logs against those driven vertically into the ground forms an immovable buttress. Out in front of the barrier, long, carefully selected lengths of timber may be laid with one end at ground level and the other braced up slantwise, forming a ramp to the barrier's peak.

The effect of the barrier is calculated with precision. The engineers learn the speed, vulnerability and firepower of tanks they will meet in battle. They learn, too, that once the tank is wedged on the pinnacle of the obstacle, it is usually a dead duck. For as soon as a tank loses its mobility, it becomes a pretty target for camouflaged ground batteries and previously set charges of TNT or dynamite.

If the tank does get over the hurdle, its pace has been slackened to such an extent that it is an easier target for almost any type of attack. The engineers quickly learn the blind spots and are taught to go right up and toss a flaming torch into the tank's interior, once its firepower is appreciably reduced.

With the tank stalled on top of the barrier, its belly becomes a target. The gunner can't very well get his sights set to shoot through the floor, and perched on top of the obstacle, all of his guns lose their effective range. They are mounted to fire most effectively on an even keel. When forced to fire through slots and from a revolving gun mounted on top, the tank gunner is in a quandary in a matter of fleeting seconds. That is all the engineers are after. That decisive split second when the tank's gun crew is momentarily off balance is the time for the kill.

The engineers also have a way of going after the tank before it even reaches the barrier. They string land mines along the path with stealth and cunning. When a tank rumbles onto a string of mines, pandemonium sets in. Likely as not, the tread gets a smashing blow that either badly cripples it or blows it off completely.



Another Tank Trap in the process of construction. Heavy logs stacked high, wedged by piling and knitted together with strong wire, stop a land-battleship in its tracks. Engineers can build one in ninety minutes.

Another trick is to dig a deep pit at one or both sides of the obstacle. If the steel charger veers to either side, down he goes into the pit. Once in the pit the tank is in an awkward position. The impact of armor-piercing shells from tank destroyer guns concealed close by often spells finis.

Sometimes the engineers set a charge of dynamite and knock out a twenty-foot crater as much as seven or eight feet in depth. The job of the tank driver then is to leap his galloping steed across the chasm at an uncomfortable speed. The favorite trick, however, is the cleverly laced trap of logs which the engineers hack out of the woods. They never tire of watching the big tank lurch crazily onto the barrier where it sways from side to side, pitching and careening helplessly at the top, with its tracks clawing at empty air.

Regardless of the type of obstacle thought up by the engineers for practice maneuvers, the tank spins down a run of a hundred or more yards at top speed, trying with all its force to smash whatever it cannot get over.

Tank drivers who volunteer for this special duty pride themselves on their reckless daring. It's a sure way to gain the respect and admiration of their fellow soldiers. They realize, too, that it's the type of double-barreled action they'll get in battle and that it's better to test courage now than wait till later when shells are flying thick and fast. To these hardy tankers it's a brand of he-man sport unmatched in any other types of training.

In actual battle a tank driver probably wouldn't get more than a couple of stabs at a tank trap, but on the testing ground at Belvoir they put the big steel giants through their nip-ups and tussles with the traps as much as seven or eight times a day.

Sometimes after an especially rough trial run a driver is rushed away in an ambulance with a wrenched shoulder, or a mean fracture. A driver has been known to come out of a tank with a cracked vertebra, or a split chin. The men get plenty of bruises in this busi-

Building Tank Traps is no white-collar job. Here is vivid evidence of strong backs being matched with the weight of heavy timber cut at the site of a potential trap. Logs are hacked out of nearby woods and lugged into position.

ness, but they like it. In fact, the special crew of drivers huddled around one of the obstacles waiting for it to get the last lick of the engineer's maul will toss coins to see who runs the M-3 onto or over the barrier.

One Sunday afternoon at Belvoir this little routine betting on the side almost became an incident of national importance.

The War Department's own network radio program, the Army Hour, had planned to broadcast a description of a tank going over one of the traps. Script had been prepared in advance and reviewed with approval by the War Department. The script writer had seen these demonstrations before and he knew the side-betting should be part of the show. He very ably wrote in dialogue for two or three tank drivers who were to be standing by, talking and matching coins to see who would pilot the tank over the hurdle.

The radio script arrived at the scene about thirty minutes before the tank trappers were to do their stint for a world-wide audience, including many fathers and mothers sitting at home by their radios. The quick-witted public relations officer took one glance at the script. "The betting dialogue must come out," he said.

Such spots, when broadcast, are timed to the split second, and the announcer was not anxious to ad lib on a broadcast describing military operations. With only a few minutes to spare, other lines were hastily written in before the broadcast went on the air. Later the wisdom of the public relations officer was evident. Had the innocent, sportsmanlike, coin-tossing episode gone on the air, the Army and the network probably would have received a flood of mail about the moral side of good Army leadership.

The testing of these tank traps has a dual purpose. First, it teaches the engineers how to make use of the materials that ordinarily would be available in the theater of operations, where actual fighting is in progress. If an engineer is building the trap in a wooded area, he knows exactly the type and size of timber he will have to cut to complete a trap. He learns too, right down to the minute, how long

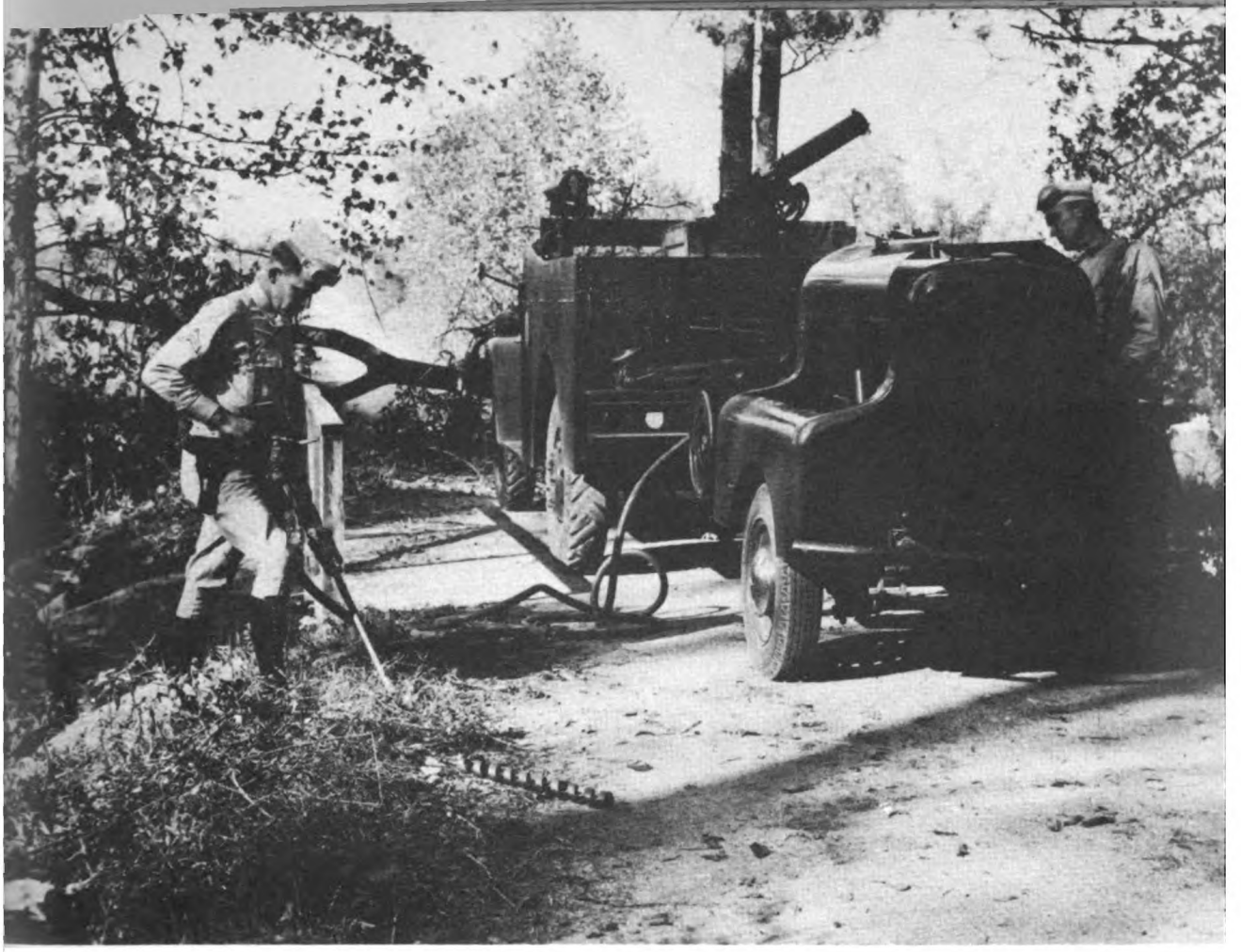
A typical engineer tank trapper with one of the king-sized mauls. Used like a sledge hammer it drives the piling into the ground as an anchor for the tank trap. After swinging one of these a few hours the engineer's appetite takes on edge. It loosens muscles too.

it will take to finish the job. This is important, since an actual battle may leave only so many minutes in which to set up one trap, or a series, that will halt a wave of tanks.

The tank trapper crews are divided into teams. They are coached by an especially trained cadre of noncommissioned officers who lead each platoon through individual training steps. By allotting a specified time in which to complete one of the traps and then dividing the groups of engineers into teams, the competitive spirit is driven to a feverish pitch, as one team works against the other. Finally the engineers are in competition with the tank drivers, who try to crush the traps they've built. The entire process is a three-cornered play of teamwork that captures the enthusiasm of every engineer, once he tackles the job. When the engineers are working against time and know they have just ninety minutes in which to set up a trap, they pitch in with the zest of a football squad in the Rose Bowl.

The day of the radio broadcast from Belvoir, the commanding officer insisted nothing out of the ordinary would be performed. The trap would go up as usual, just as the engineers did it day in and day out as they practiced for war. There were to be no frills and fancies or added thrills for the radio audience. As it turned out there were thrills aplenty, but they weren't rehearsed or planned.

The scene was a narrow dead-end road, cut in a thickly timbered area, and the huge trap stood at the end of the lane. Negro engineers were putting the finishing touches to their masterpiece as the observers arrived. Big husky colored troops with muscles bulging, like so many duplicates of a Joe Louis, swung their 20-pound wooden mallets with measured rhythm. They hummed and chanted as they worked. Occasionally there was a trickle of laughter, a boisterous yell, as one of the king-sized engineers clipped off the latest joke. There were no orders barked at laggards, for there were no laggards in that crew. They sweated and heaved, tugged and yanked at the big logs as they rolled them into place. Across the road from the trap other engineers were clearing the road of debris. They were anxious



Here an engineer operates an air compressor, one tool of the demolitions platoon. Holes are drilled, explosives inserted. The explosion will leave a jagged crater to slow down or halt the enemy while he makes repairs.

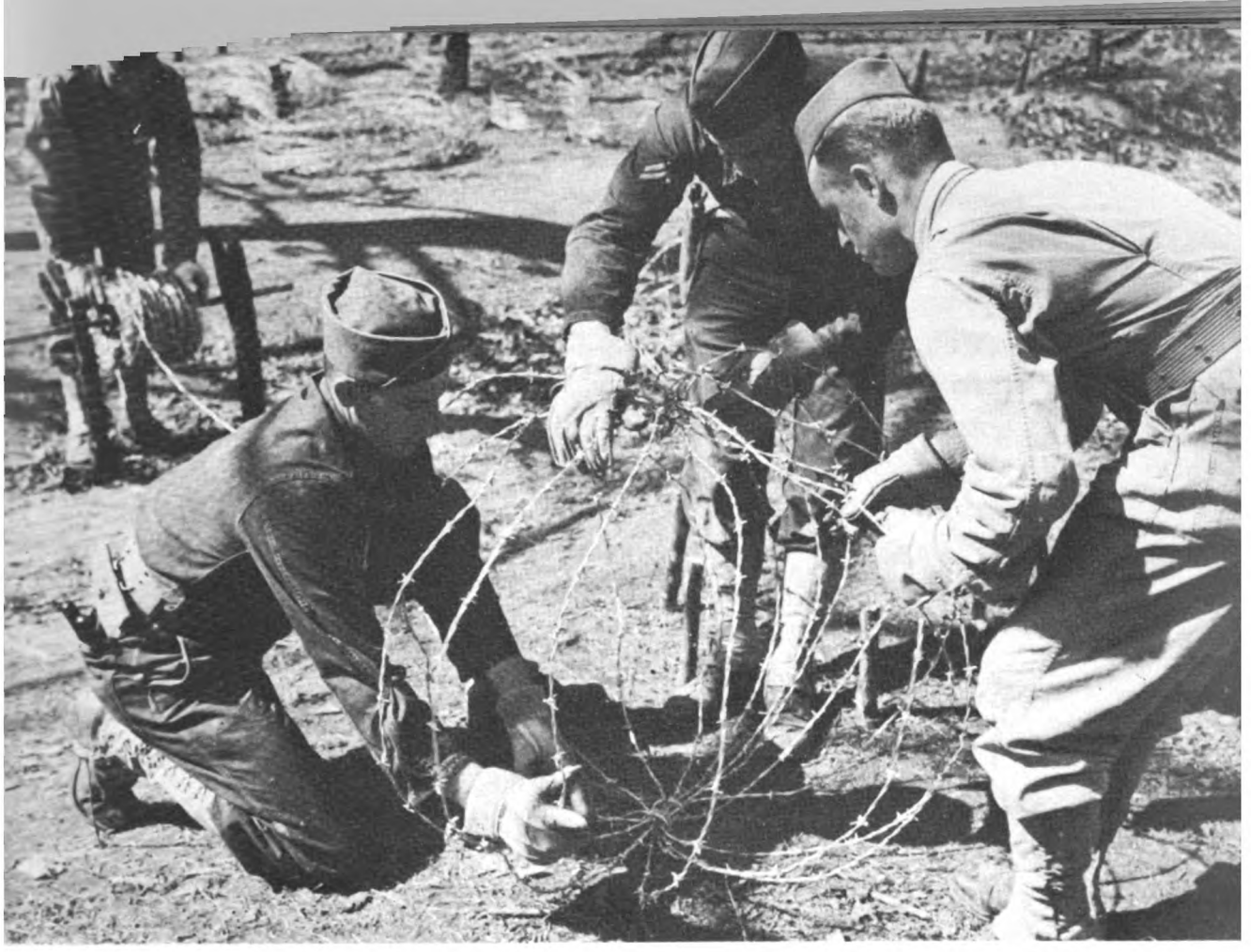
to see the big "sardine can" unreel all the speed it had before plunging into the trap. One could sense the suppressed excitement and silent hope. They would like nothing better than to see the tank make a mad dash up the road and land bottom side up in that pile of logs.

The platoon leader kept an eye on the watch. They were going to finish the job on time—in exactly ninety minutes. Up near the barrier two husky engineers were driving the last stake. Each time a mallet struck, the ground shook twenty feet away. There was no doubt about it, these engineers were as tough as shoe leather, and healthy as young wildcats itching for a battle.

All eyes rested on the big barrier at the end of the road while tense, exciting minutes ticked away. Grinning enthusiasm rippled and spread from the first to the last man in the platoon. The last blow fell on the final stake to brace the obstacle, and the sergeant made a note in a little pad. The crew had come through on time. The obstacle was built in a crib-like form nearly five feet high. Logs were laid parallel, one on top of another, until they formed a triangular pattern. Heavy braces holding the walls in place were driven vertically into the earth and protruded approximately two feet above the top of the trap.

The engineers had built a ramp from three or four heavy logs that led from ground-level up to the surface of the trap. This was to get the tank up off its treads once it smashed into the barrier, thereby losing its traction after the treads were lifted free of the ground.

Meanwhile, it was almost time to go on the air with the broadcast. The engineers began to smother their laughter and cheerful bantering. About a hundred yards up the road the tank's motor idled. The radio engineer motioned the announcer to get ready for the air. The captain cautioned all hands to clear the decks for action. The radio announcer was on the spot. He had to see the whole works and tell the story in seconds. Still he wasn't anxious to get too near the



Engineers are masters at road-block improvisation. Barbed wire is skillfully tangled, planted in the road and left for unwary enemy vehicles. Once wheels are enmeshed in the wire tangle there's nothing left to do but stop, get out and cut the wire from around wheels and axles.

barrier for fear the flying timbers would flip into the air and his head might be in the way of them. Nevertheless, he should be awarded some kind of announcer-hero medal, for he inched up to within twenty-five or thirty feet of the barrier with a microphone, and waited for the full force of the flying dreadnaught.

The captain gave the signal. The radio engineer motioned the announcer and he swept into his dramatic play-by-play description of the event. The giant M-3 tore down the road like a scared rabbit. The motor backfired and snorted smoke from the exhaust as the tank hit the small barriers which had been placed in front of the large central obstacle to throw it off its course.

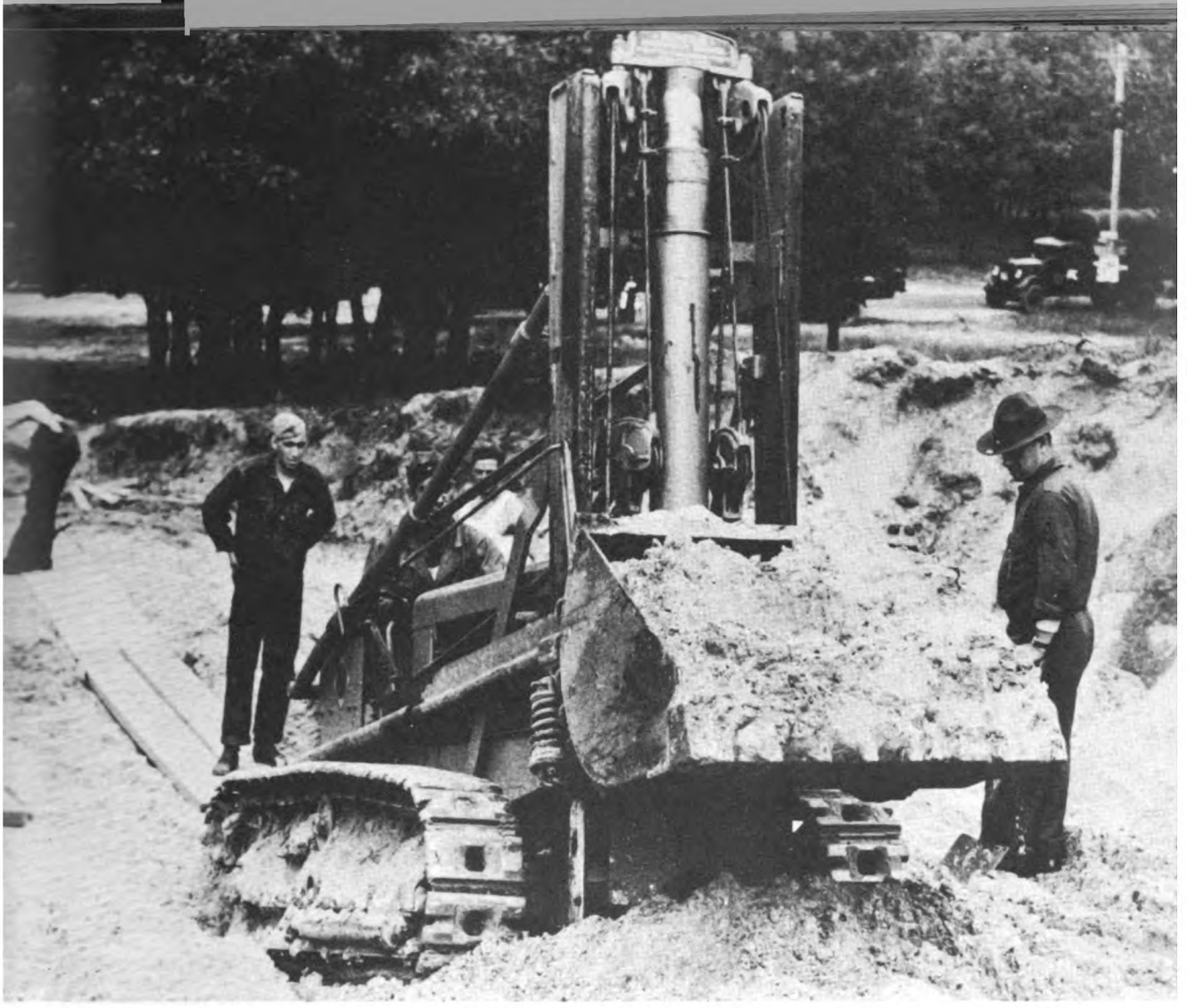
The announcer paled, but stuck to his post. As the lurching tank crashed into the barrier, pieces of timber that would have cracked a man's skull flipped through the air in beautiful arcs and landed in the opposite direction.

Up to the peak of the obstacle went the tank, but one of the big vertical poles jammed the tank's belly and lifted the front end skyward. The driver, fearing the tank was going to flip forward onto its back, shut off his sputtering engine. He knew his "sardine can" had reached its limit, and he had no desire to land with the thirty-ton tank's treads pointing heavenward.

As the tank clung to the top of the obstacle, yells, whoops, and screams of laughter split the air. The engineers had whipped the tank again! It was a victory not to be tossed off with reserved satisfaction.

Quick-thinking tank men rushed up to the monster and lifted the bruised tanker out of his smoking steel hulk. There is always the danger of fire, once a tank hits the obstacle, since fuel lines and wiring may be cut. A cut fuel line and shorted wiring occasionally may set off sparks that will wrap the big tank in flames. As the tankers lifted their mate through the hatch he was wearing a sheepish grin. He had put on a man-sized show, although it was just another lunge at a trap for him, all in the day's work.

There are several types of these tank-stopping barriers, although



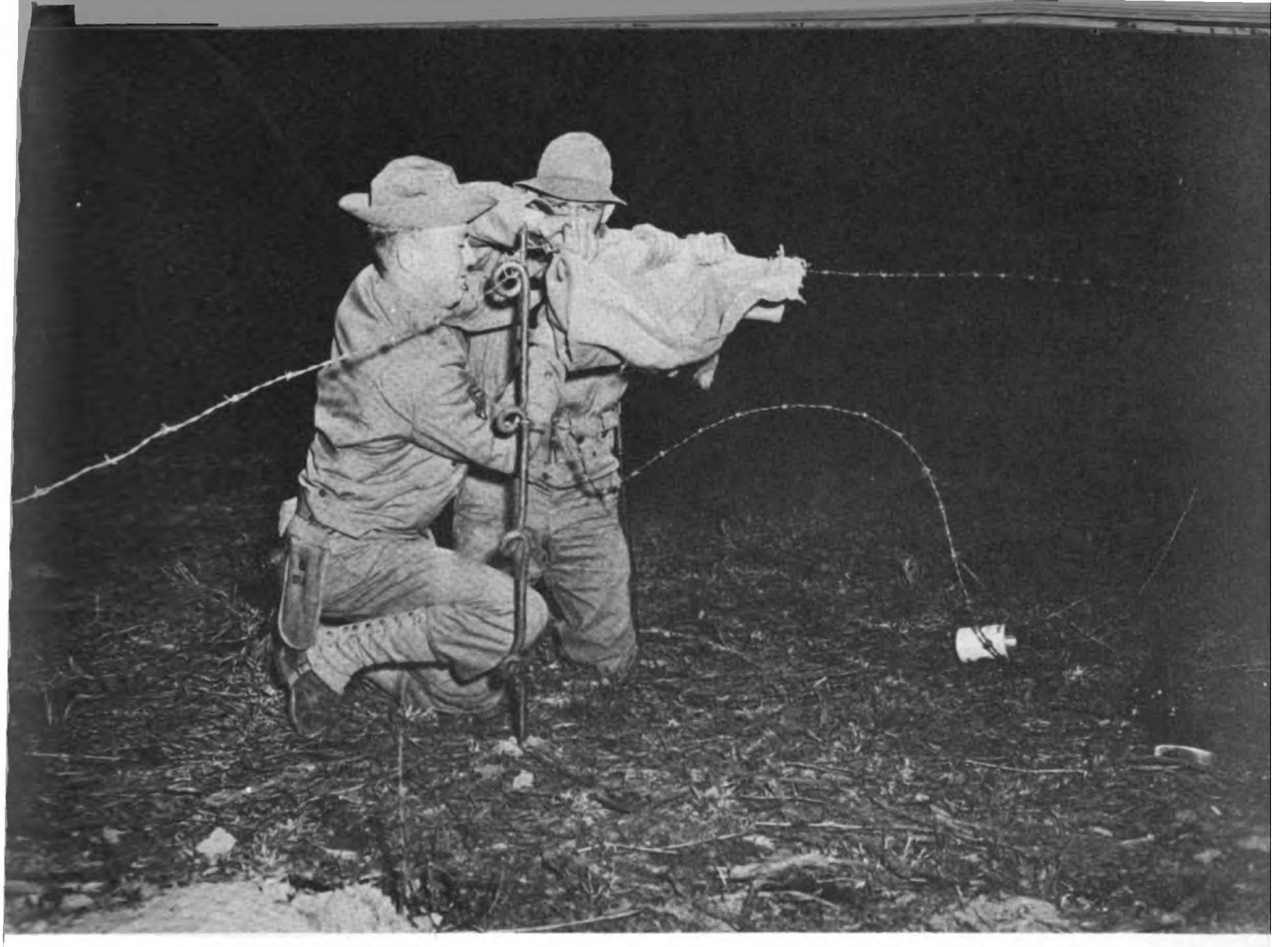
There are many types of tank traps. Equipped with a carry-all these engineers scoop out a crater in short order. In absence of such machines, explosives correctly applied do the same trick. Once in a crater like this a tank becomes a vulnerable target.

two stand out as favorites of the engineers. One is the crib filled in with stone or dirt and chunks of logs for stability. It may be constructed either in the form of a ramp or as a vertical wall. Then there is the sawhorse type, built of a connected string of semi-ramps with a high center and raised at the end in the direction the tank would be moving.

As the engineers are taught to build the obstacles, they are also schooled in selecting sites for such structures. The object in this is to foresee the probable direction a tank will move, by judging the character of the terrain. The engineer is shown that under certain conditions a tank will take to a gulley or attempt to move along between two high embankments. In such circumstances the engineer would build his trap at the bottom of the gulley, the path most likely to be taken by the tank. Then, too, they are instructed in dispersing their traps in order to channel tanks into gunfire or onto soft ground where they will bog down in the mud.

The engineers recently found that a plain ditch will stop a tank as quickly as anything if the crew has to pile out and fill the ditch before crossing. The engineers have worked out some unique methods for creating ditches at a rapid pace. Using an earth auger, which is a common engineer tool, they sink a line of holes with a 16-inch bit. They drill them five feet deep on five-foot centers. Into each of the holes then goes a 50-pound charge of carefully prepared dynamite, nitrostarch or TNT. The holes are tied in a series by means of wiring and detonated simultaneously. By this method a ditch as deep as ten feet can be ripped across a stretch of ground at rapid battle tempo.

One engineer officer explained that a skilled crew of eleven men, using an earth auger, could knock out 100 yards of ditch in four hours. At that rate, the eleven-man engineer crew could build ten traps in four hours if each was a thirty-foot ditch. As rapid as this method is, the engineers still must stick to the use of timber in many instances. Their primary purpose in building traps is to throw the



Another road-block. Engineers string this one up in a hurry. An enemy dashing down a dark road like this on a motorcycle or in a jeep-sized car may be decapitated or badly mangled.

tank off its course or out of balance. To accomplish this, timber can be used in many clever ways to make the tank feint and lurch from side to side, exposing vital spots to concealed gun positions.

Tank-trapping is an important phase of the engineer's Army job. However, the engineer knows that he must always depend on supporting fire or tank destroyer units with their armor-piercing shells to perform the knockout blow, or his trap-building job serves no purpose. Engineers must work in unison with other branches. To that end the engineer is trained, for he is part of the Army team.

Chapter Seven

DEMOLITIONS

GALLANT ENGINEERS OF General Douglas MacArthur's army had been fighting for weeks. Rations were short. Occasionally wild boar and mule meat was their fare. Through malarial jungles and mountains they had made the Japs pay with blood for every inch of ground they gained. The engineers were tired and worn from loss of sleep and ceaseless shelling, but they fought on. General MacArthur, an engineer officer himself, knew well the courage of these fighters.

Dawn was just breaking over shell-torn Luzon on New Year's Day, 1942. Four generals stood on a vantage point close by a bridge. The bridge lay on the route over which the Philippine forces had fought a bitter retreat. Suddenly an earth-shaking blast roared defiance at the onward-rushing Japs. The big bridge buckled and collapsed, a perfect job of destruction. The engineers had blown up the bridge to give the retreating army time to dig in and hold off the Japs a few days longer.

The bridge, known as the "Calumpit," was a three-span structure 650 feet long, and was one of the most important of those rendered useless to the Japs. Before it was destroyed by the engineers, the entire Southern Luzon Army had crossed it to enter Bataan.

While the engineers fought their retreat across rugged Luzon they built and destroyed bridges, laid improvised land mines, and turned water-buffalo trails into passable roads for the army. But in their clever handling of explosives they stalled the Japs in many a critical hour. In northern Luzon alone, the engineers under Colonel

Harry Skerry of Portland, Oregon, destroyed nearly 200 bridges, including one thirteen-span structure. In this one campaign of destruction the Philippine engineers used more than 200 tons of dynamite.

When the history of this war is finally written, it will reveal some critical turns of battle effected by the skilled engineer and his satchel of explosives. For example, in the Far East the British unleashed a campaign of destruction in vital oil fields, probably unequaled in history. But in some areas, such as those around Penang and Singapore, they were unable to complete the job before the Japs moved in. The fact that much oil in that area was available to the Japs will probably be an important factor in prolonging the struggle for Allied armies in retaking the territory.

The Russians have become past masters in this wholesale spreading of destruction by means of explosives, so much so that this tactic became a war policy—the "scorched earth."

The soldier tagged to become a military engineer in the U.S. Army is in for plenty of dynamiting. During one period of his training he learns enough about explosives to blow up the Golden Gate Bridge or the Holland Tunnel, or crack a two-ton safe, if he should be so inclined. "Demolition" is the Army's name for this course in ready-made havoc. It means the art of taking explosives, assembling them by hand in proper order and appropriate amounts, and exploding them personally, or by setting concealed "trips" which set off an explosion on contact.

All engineers get instruction in demolitions. It is a part of the basic training. Before the engineer gets through this highly exciting course in academic premeditated mayhem, he is well versed in the technique of wrecking docks, bridges, houses and factories, and in the art of laying land mines, and blowing huge craters to halt onrushing tanks.

The engineer also receives generous instruction in different methods in which explosives may be used in a direct assault on a pill box, a machine-gun nest, or a tank or armored vehicle.

The engineers of our Army get acquainted with the business of

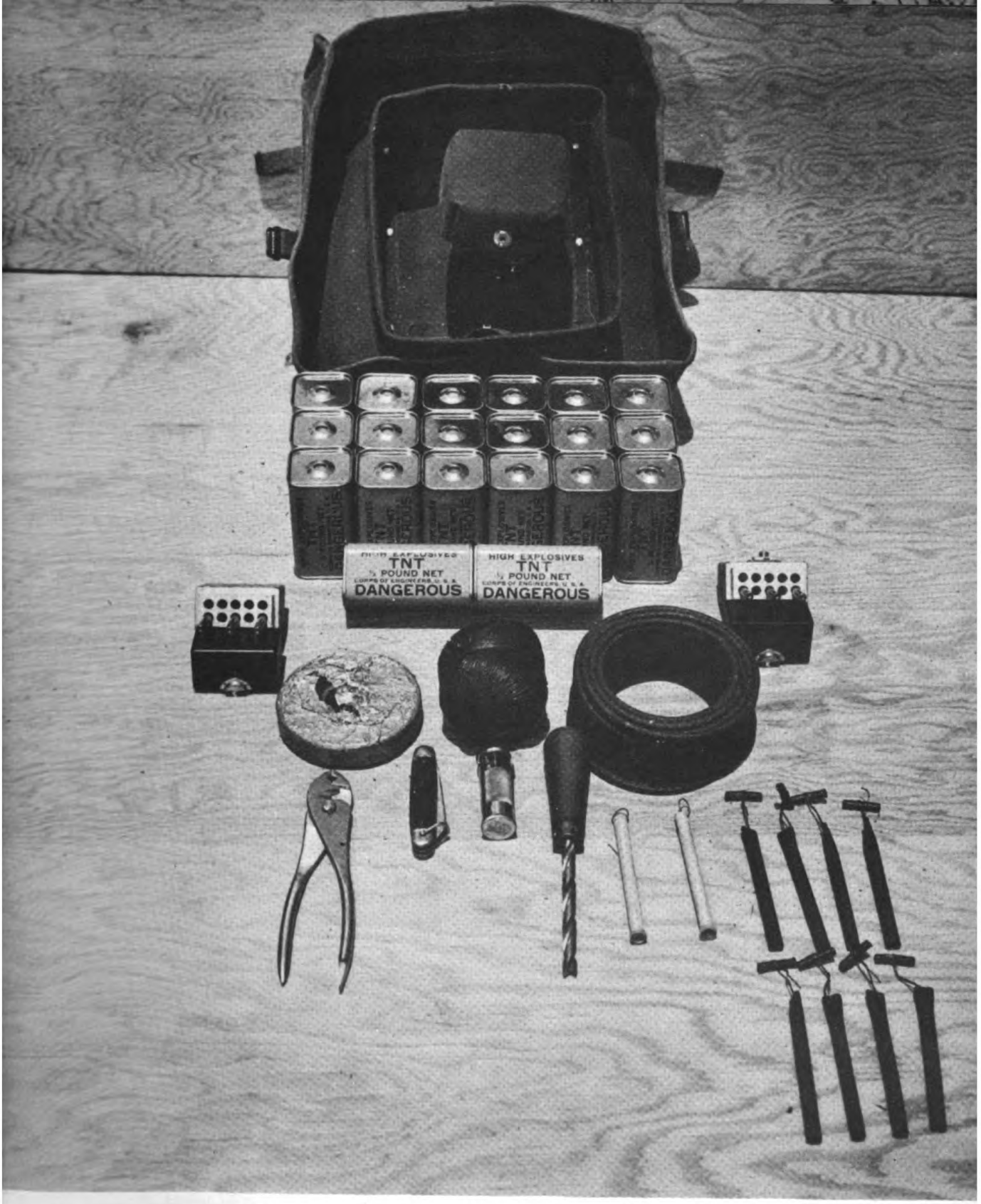
Demolition detail. Here one trainee gets set to plant a dynamite charge. Shielded by the tree trunk and covered by his teammate the soldier moves cautiously toward his objective. Very soon the bridge upstream will be in need of repair.

planned destruction at Belvoir and Fort Leonard Wood. At Belvoir there is marked out on the reservation a zone used exclusively for the training in demolitions.

On this dynamite-riddled range there is no kid-glove handling of the young engineers. They learn about the real thing. They practice with dynamite and nitrostarch, although in actual warfare the engineer would probably use TNT (trinitrotoluene), which is a much more powerful explosive. The only reason the engineers don't use TNT in their training is to save it because of its scarcity. TNT is the regulation explosive generally used in combat areas. It is comparatively safe to handle because of its insensitiveness—it requires an exceedingly high explosive detonator. Dynamite actually is more dangerous than TNT to handle, for it is highly sensitive. Much of the training of the engineers is carried on with the aid of nitrostarch, which gets approximately the same effect as TNT.

As the engineers learn about these explosives they find that the art of demolition is important. It is an effective offensive weapon which can be applied in many ways. The assault squad of engineers assigned to wreck enemy communications, bridges or railroads must be masters of their trade. They must, the engineer learns, know the vital spots to which the explosive may be applied to get satisfactory results.

Out on the demolitions area at Belvoir the engineers toil and sweat while they build a culvert, a bridge or a concrete blockhouse. Then they pack up their satchels of dynamite and nitrostarch and launch an offensive on their handiwork. Then again they march out to the demolitions area, loaded with explosives, and pick out a carefully cut stretch of roadway. There are several ways of completely tying up traffic, they discover. They find, for instance, that simply to plant explosives anywhere along the road and set them off does not do the trick. The enemy could, if he were proceeding with haste along that stretch, detour around the big crater. But the instructor says, survey the territory your road passes through. If possible, pick out a



Armed with this innocent looking "demolitions kit" an engineer can literally create havoc. Compact, light, handy, it contains enough explosives to make the engineer soldier a formidable opponent.

section with a culvert or bridge, then knock out the bridge. Even if the road goes through a low, swampy stretch, and does not cross a bridge, blow out that section at the center of the swamp. Then when the enemy tries a detour his heavy tanks and trucks will bog down. While the train of trucks is strung out behind the lead vehicles, your supporting aircraft can pick them off with bombs as they pile up behind the lead truck or tank.

Then again, says the instructor, if your road leads through a thickly wooded area, take to the timber. In this operation the engineer simply ties a belt of explosives around the base of a tree, places it so the force of the blow will land the tree at right angles across the road. Several big trees laid across a road every few yards will play havoc with a motor train on the march. Often a delay of half an hour or even fifteen minutes may mean the difference between defeat and victory in a well-timed action.

When the engineers begin learning how to attack pill boxes, the going gets hot and rough. There is, in fact, no period during their training with explosives, when the engineers find time for boredom. The instructor may have the pill boxes located in a fairly well-fortified position, just as would be the case in an actual battle area. The engineers are told to take the pill box. The area around it may be carefully strewn with land mines. The student engineers must make their way with great stealth through the mined area, before they reach their objective. Of course, the mines are toned down in explosive power, but they still make a realistic noise.

After he has passed the land mine, the engineer gets near the pill box. Meanwhile, he may have had to cut his way through a barbed-wire entanglement, or blow his way clear with a bangalore torpedo. Once through all the barriers, he's set to go to work on the pill box. During his training the engineer has learned that nearly all pill boxes have at least one blind spot. It is his job to find that spot. Then he lets go a stream of fire with his flame thrower. The fire gives off a heavy cloud of smoke which conceals the engineer

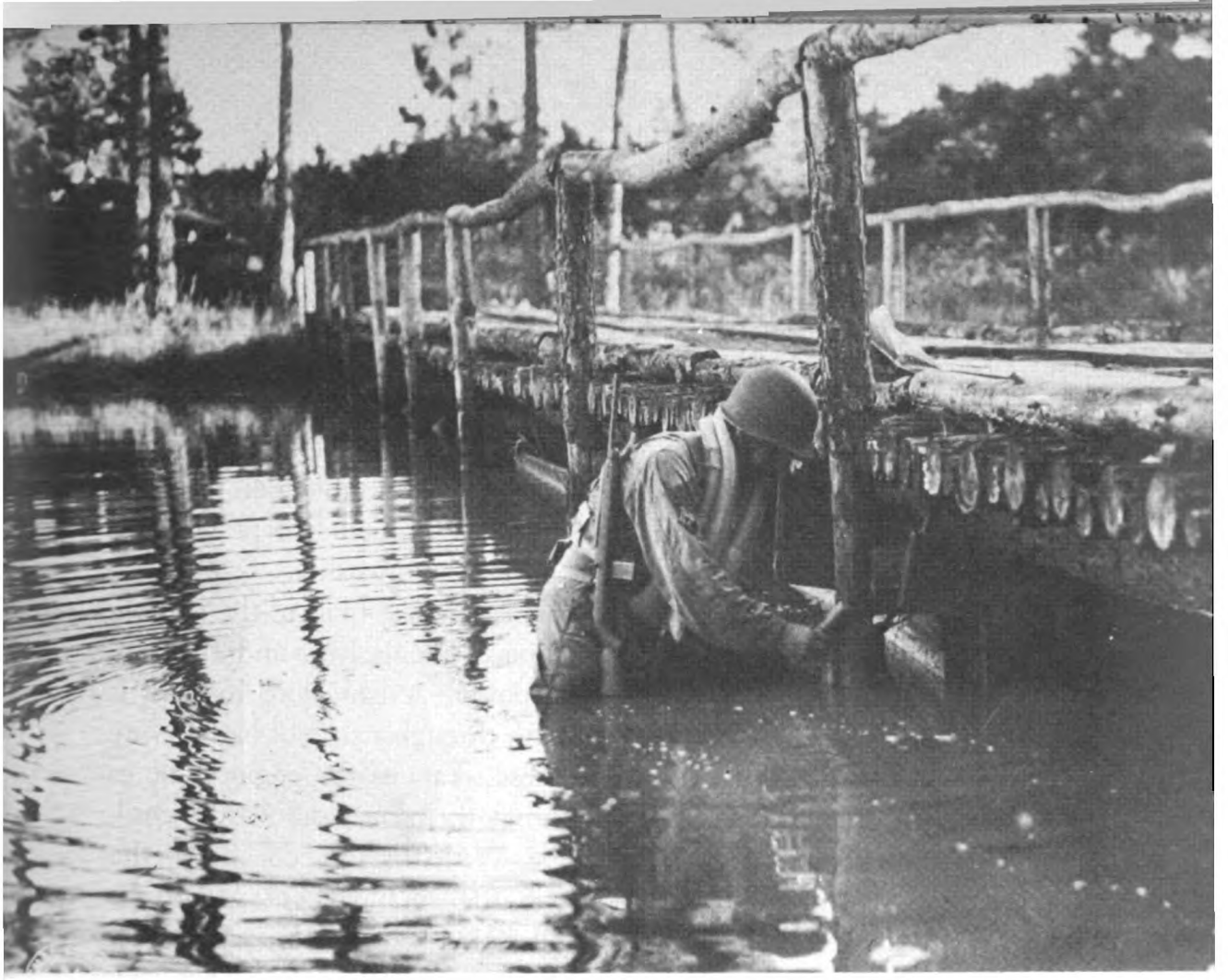
Planting a deadly charge of dynamite under a culvert. After the explosion the "enemy" can chalk up this culvert on his map as "impassable."

and keeps him from becoming an exact target for the machine gunner. Once up to the blind side of the box, the engineer may elect to burn the occupants out, in which case he can slip the snout of his flame thrower through a gun slit. Otherwise, he takes a satchel charge of explosives tied to a string on the end of a long stick. He can either toss it over on top of the box and explode it, or sling it around the base, and still have some degree of protection from the explosion. This is a combination guerrilla-commando type of fighting the engineers enjoy practicing. It never grows dull.

The bangalore torpedo is one of the handiest tools of the demolitions squad. These the engineers make themselves, and they are packed with plenty of destructive power. A bangalore torpedo is most useful as a tool to open up a path through a strip of barbed-wire entanglements. To make one of these weapons the engineer bores holes in several blocks of TNT, strings them on a detonating cord, then inserts them into an iron pipe. With the torpedo all set, the engineer creeps up to the point in the entanglement where the pickets hold the wire in place, and slips the long iron pipe under the wire. He then lights the fuse and makes a wild dash back to a trench or shell hole for shelter. The resulting explosion slits a clean strip right through the wire. The way is then open for troops to move ahead through the tangled barrier.

It seems a paradox that the engineers should labor to the point of exhaustion, through daylight and dark, to build a perfect bridge and come back the following day and blow the bridge into a thousand pieces. But this is the way of war. And engineers do a thorough job of learning the tricks of their trade. It is important that the engineer know how a bridge is built in order that he may know how to destroy it. In battle he may build a bridge one day, and his troops will pass over in an advance. The next day they may be forced to retreat. It then becomes the engineers' job to destroy the bridge to halt the enemy.

To get at the vitals of a bridge, the demolitions engineer must



Engineers are trained as experts in the use of explosives. When this charge is set the engineer will scurry for shore and cover. Destruction of the bridge will mean loss of precious time to the enemy in crossing the stream.

know exactly how to set his charge of explosives. If the bridge is set on large concrete pillars, he learns to swing down on a rope or paddle out to the water level in a pontoon boat, drill a couple of holes, insert his explosive, wire it to the detonator and paddle back to shore. Once he is clear of the structure, the several charges strategically set at carefully selected spots will bring the bridge down.

In the South, a county had relocated the highway through an area and left a bridge standing which served no purpose. The engineers got permission from authorities to include the bridge in their maneuvers as a side show. They went to work on it like beavers. They unsheathed their pneumatic drills, punctured the cement pillars, loaded the bridge with explosives and set them off. The bridge was left a total wreck. And the experience was real two-fisted engineer stuff. The metal was salvaged, the engineers had a lesson in real war, and the people of the county no longer had an eyesore.

The demolitions engineers get all types of training. But the most exciting stretch is perhaps that of cooking up "booby traps" and denuding them of their sting. Booby traps have caught the public's fancy perhaps more than any of the many unique war tricks thus far. The Germans were the first to employ them in the present war, although they had been used extensively in the last World War.

A booby trap is technically known to the engineer as an anti-personnel mine. The range of their use is almost unlimited. The aim of the trap is simply to kill or mangle all within the reach of its explosive power. In all cases the booby trap is connected by a string or wire to an object which is likely to be picked up or moved by a soldier. For instance, in the present war the Germans in their retreats in certain areas left flashlights, fountain pens, wallets, and other carelessly strewn objects. They would leave them lying on a piece of furniture in a house, or in the middle of a walk, along a road or a footpath. The soldier or civilian who happened to pick such an object off the ground or lift it from a table sets off an explosion with disastrous results.

These colored engineers learn to fell a tree without an axe. This necklace of dynamite will sever the trunk at one blow. The tree will fall across a road thus blocking enemy traffic.

While troops move through a certain area a soldier sees a shovel lying in the road. His first inclination will probably be to pick it up and toss it aside. When he grabs the handle of the shovel to lift it, a tiny concealed wire connected with a sizable charge of explosives buried beneath the shovel explodes. Down goes the soldier and all others within reach of the charge.

The traps may be fastened to doors or windows, the drawer of a desk, a water faucet, or a package of food lying on a cabinet. The imagination of the engineer setting the vicious traps seems to be the only limit to their deadliness.

When Field Marshal Rommel's forces retreated across the desert they left many houses mined with booby traps. The British simply sent ahead their engineer specialists, who fished out the location of booby traps, painted huge signs on the houses in which they were planted, and the troops who followed gave these places a wide berth.

One of the features of graduation training exercises at Fort Belvoir is a practical workout in setting traps and getting through areas sprinkled with these death-dealing gadgets. The engineers are organized into teams. One team goes into the area marked off for the game. Members of the team are armed with rubber bands, mouse traps, nails, flashlight batteries, copper wire, detonating caps and firecrackers. The firecrackers are substitutes for the real thing. But engineers who trample on them or disturb one of the traps after they're set get some hair-raising shocks.

The engineer team with all of the assorted collection of paraphernalia strings out through the woods. Some set traps around trees, across footpaths or in small buildings scattered over the terrain, then they retire to the side lines. Meanwhile the instructor marshals the other team and it is instructed to clean the area of booby traps.

Then the fun begins. It is a small-sized edition of "Hellzapoppin." There are yells, shrieks, groans and shouts, mixed with explosions. Some of the more careless engineers get a good scorching. Occasionally one gets a rather severe powder burn. Of course, it's only

Landmines are effective road blocks. Here the engineers sow them in methodical fashion. Highway then becomes a dangerous lane of travel for the enemy.

practice and the engineers know the danger is very slight, but they are careful nonetheless. Eventually, the grinning victors assemble after the systematic prowl through the area. Then the lads who set the first booby traps are on the receiving end. The hunters become the setters.

This process goes on repeatedly week after week as each new group of engineers pursue the basic training.

Booby traps are not new. In fact, they're quite old as a warfare trick. And neither were the Germans the originators. Only recently was it discovered that booby traps were employed in skirmishes with the Seminole Indians in Florida as early as 1840. The man who is credited with first making use of such devices was a Captain Gabriel Rains. He had served at many different Army posts in the South and West. For a time he was stationed in the Indian Territory, which is now Oklahoma. Rains eventually became a lieutenant colonel in the regular Army. He also served as a brigadier general in the Confederate Army.

According to the stories recently unearthed dealing with Captain Rains, in 1840 he was serving with troops in the wilds of untamed Florida and they were having no little difficulty with the wily Seminoles. The Captain hunted out one of the frequented Indian trails, planted a shell in the path and covered it with a shirt. Along came an Indian who picked up the shirt, which had been fastened to the shell to make it explode. It did, and the Indian went to the happy hunting ground.

Flushed with his success, Captain Rains is said to have gathered up four more shells, put them in a blanket and carefully planted them in another frequented trail. The Indians were watching. They tied a cord to the blanket and exploded the shells. At the sound of the explosion the Captain raced to the scene with his men. As they moved up to the scene a dead 'coon was found in the trail. When the party halted to move the 'coon's carcass, the Indians hidden near by let go with a volley. The Indians had turned the booby trap technique on the good Captain and his men.

Chapter Eight

ARMORED ENGINEERS

"KILL BEFORE YOU GET killed!" That's the battle cry of the Tank Destroyer Command of the Armored Force. A snarling animal's face that has all of the marks of a tiger crunching a tank between his sharp teeth, struck off in golden yellow and black, is the insignia of this outfit. Circling the insignia are three dynamic words: "Seek—Strike—Destroy."

The Tank Destroyer Command is a new war baby. It is the potent wing of the Armored Force in combat. Its reputation will probably mushroom as the war progresses. The Tank Destroyer Command is designed to work like a charm with its offensive brothers, the tanks of the Armored Force.

The overall strategy in which this unique force is most effective includes advance by the tank force to antagonize the enemy. The enemy counterattacks and smashes into the tank destroyers; then the Armored Force tank wing, combined with destroyers, all their guns blazing, wreak havoc in enemy ranks. Thus, working like a seesaw, the tank destroyers carry out their mission in a demonstration of excellent teamwork.

Just as it is the engineer's job to make the going easier for the Air Force, by building airfields and maintaining them, so is it one of his jobs to make the going easier for the Armored Force and its components.

Whether he operates with the tank destroyers or the tank forces, the engineer will build bridges, lay mine fields, make maps, erect

anti-tank obstacles or insure water supplies, depending on the type of unit to which he is assigned.

The engineer who is assigned to the Tank Destroyer Command, for instance, is already a master of the fundamental tank-killing technique. He has had basic training at one of the replacement centers, where he has already learned the rudiments of soldiering and has been toughened to the grind.

The center of training for the Tank Destroyer Command is Camp Hood in Texas. Here, on a sprawling reservation of more than 100,000 acres, some of the hardest practice fighting in the world goes on continuously for thousands of men. When the engineer arrives at Camp Hood he is ready to learn his place on a war team.

Pity the poor engineer who isn't ready for this amazing testing ground! The engineer thought the replacement training center was tough, but "he ain't seen nothin' yet!" Camp Hood bars no holds. Before the engineer gets through two months' training here, he's ready to fight a bear without gloves or weapons. They do everything with the soldier at Camp Hood but make him eat raw meat.

Immediately the engineer senses something of the mobility, toughness and virility of the Army in which he fights. Right off, he finds himself crawling and twisting his way under jagged strands of barbed wire with machine-gun bullets zipping and zinging through the air not more than a foot or so above his head. This is called practicing under fire. Some of the soldiers say it's hell. To make matters more realistic, dynamite, grenades and land mines will be knocking the breath out of the soldier as he inches ahead over the torn stretch of ground.

This is real two-fisted battle training. Erected on the reservation is a miniature Nazi village. Running down the streets of the mock town, the engineer in training with forces there learns to use a .45-calibre pistol. He dashes up or down the street firing at weaving targets mounted in doors or windows. Booby traps are scattered

about the place by the dozen. The engineers have set up these devices so that they will know how to deal with the killers.

Out on the great Texas reservation of Hood there are miles and miles of ranges, hundreds of acres of no-man's land. This stretch of ground looks as if it has been hacked into shell holes, ridges, ditches and pits by the buck teeth of a gargantuan monster. It is pock-marked by flying shells, dynamite and land mines. This strange stretch of territory is a curious class assembly field, where the dealing out of death to men and tanks is the major subject.

On the tank-hunting course is where the men actually get close to their creator. Here danger is on every side. In special classes with instructors who have had a tour of fighting in Europe or the Far East, these future tank killers learn the fine art of demolition as it's practiced under fire. They make and test grenades right on the spot.

While the men watch with eager eyes, the instructor will take a plain sock, fill it with dynamite, coat it with ordinary heavy motor oil to make it stick to the side or top of a tank, and then with his pitching arm let fly at a target set squarely in front of the class. He turns around, and with all eyes glued to his every move, the instructor proceeds to make up one of the familiar Molotov cocktails, which may be a bottle of gasoline mixed with a chemical that explodes when it is slammed against the side of a tank.

Virtually every communiqué from the battle front contains some news of action in which our Armored Force is engaged. We have also seen many local news stories detailing the striking power of the Armored Force. But to know how the engineers are welded into this powerful hard-hitting mechanized outfit, we should know something of its organization and function in battle.

In a War Department training circular its function is couched very simply: "The primary rôle of an armored force," it says, "is offensive operation against vital objectives in rear of the hostile main battle positions, usually reached by a penetration of a weak portion of the front, or by the encirclement of an open flank."

Due to its relatively high mobility, the Armored Force can operate effectively in several different ways. For instance, it may be attached to a larger force, operate independently as a mechanized corps including armored divisions and mechanized divisions, or be employed in any type of offensive. The general plan of operation of the Armored Force does not include defensive action, and generally in battle it will be relieved immediately in the defensive, possibly by air support or by tank destroyer elements.

Actions in which the Armored Force most likely would be employed would be the quick seizure of a critical area, a rapid stab through a gap in the enemy line, an encircling or enveloping movement, a penetration by force of the enemy, a steam-roller push and hot pursuit of fleeing forces, or a spearhead attack against a weak salient. As long as the Armored Force is in no danger of encirclement, it may be employed to fight a delaying action.

An armored division normally is composed of a team of five echelons. They include command, reconnaissance, striking support and service. Success of any action in which the armored division participates is in the close-knit coordination and teamwork of all units.

In the command echelon there is the division headquarters, headquarters company and a signal company. The command echelon is responsible for direction of operations for the entire division. The Signal Corps unit attached to the command is set up to transmit orders, information, and reports to all units of the division.

Normally there are two components of a reconnaissance echelon. One is ground reconnaissance battalion. The other is air, comprised of the observation squadron. The air unit gets the job of searching out enemy installations in the frontal area and surveying the forward area in general. The reconnaissance battalion verifies the information brought back by the air squadron, and this may be the engineers' first entrance into the picture. The aerial observation furnishes reports on bridges and terrain, and locations of partially concealed forces.

It then becomes the engineer's job to work on the ground well in advance of the armored force, reconnoitering the area. He moves cautiously through the advance area, which is perhaps photographed by the observation unit. He looks at the bridges, if any, which exist in the area. He determines whether they are substantial enough to carry the weight of the armored vehicles. He surveys the potential crossing sites for bridge operations, establishes the location of the roads or channels through which the armored force will pass in advancing. When the aerial reconnaissance pilot has returned with photographs of an area, it will be an engineer topographical unit, probably attached to the command echelon, which develops the maps from information provided by engineers on the ground added to that provided by the air observer. The information generally provided by the reconnaissance echelon is normally the basis on which the commander bases his decisions for action.

The striking echelon of the division includes two light armored regiments, one medium armored regiment, and one or more field artillery battalions. Of course, the tank is the star weapon of the striking echelon. The place, time and effectiveness of the striking echelon's mission is determined by the combined operation of all the other echelons together.

An engineer battalion, an infantry regiment and an artillery battalion make up the support echelon. The support echelon's job is one of consolidating the position after ground has been gained by the striking force, or to seize ground sliced away from the enemy by tanks and hold to it. The support echelon is also called on to protect the tanks while they are refueling and preparing for the next forward advance. It also holds off the hostile forces should the tanks have to fall back to re-form their attack.

It is with the support echelon that the engineer battalion gets its real workout. Here it goes to work reinforcing bridges, or throwing pontoon bridges across rivers and streams at crossing points. It may

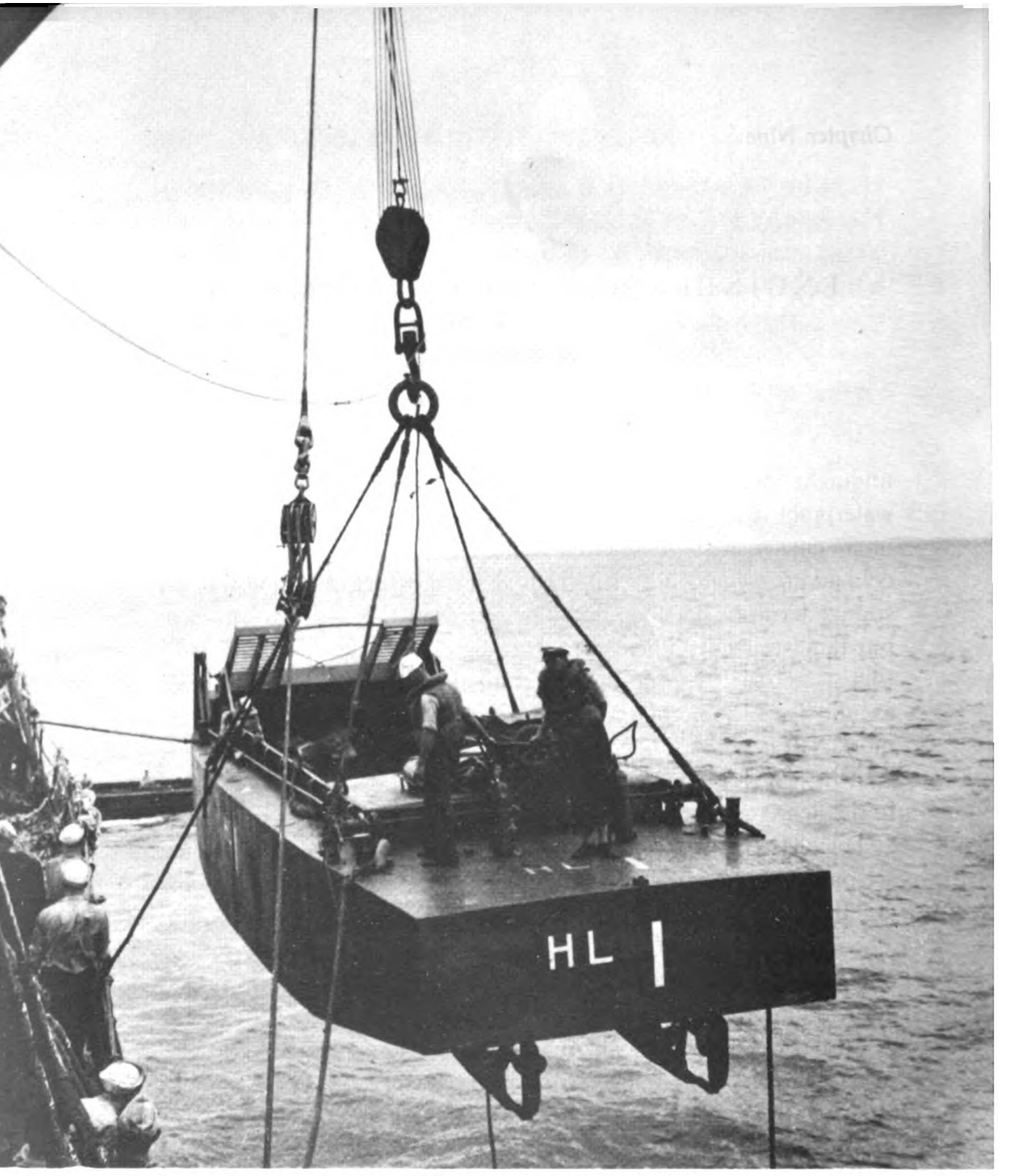
also be called out to erect road blocks to impede hostile forces. It may be required to build tank traps and lay land mines on the enemy's flank.

The fifth echelon is the general service unit composed of ordnance battalion, quartermaster battalion and medical battalion. Its function is to furnish equipment and miscellaneous supplies. It also provides the mechanics to do the repair jobs of the many types of mobile equipment with the Armored Force. It also provides food and fuel which may be extremely difficult for such a fast-moving fighting machine. The medical unit, of course, is responsible for evacuation of all wounded from various units in battle and to provide necessary first aid and emergency treatment.

The versatility of an engineer soldier with the Armored Force must be outstanding, yet he must be skilled at specific tasks. It may be map making, operation of water-supply equipment, bridge construction, or acting as a demolitions expert, for all of these skills are called into play at various periods of action, and each is an indispensable function. In addition, it must be remembered that he has to be a combat soldier as well.

An armored division may consist of some 10,000 men, including officers and enlisted personnel. It may carry as many as 300 light tanks, 125 medium tanks and nearly 1400 other pieces of mobile equipment, including trucks and motorcycles. Moving this tremendous army of heavy equipment and men over a rugged, battle-torn terrain over which every foot of the way may have to be fought, constitutes a gigantic engineer job. Obviously, in battle the division cannot be concentrated into a regulated, well-spaced motorcade. It must be spread out in tactical formation and move perhaps over half a dozen or more routes. Some of the division's units must be moved carefully and speedily. To meet these exacting demands the engineer finds a tremendously difficult task in his road, bridge and maintenance job. In addition, he may be the king-pin in a defensive action in which his tanks and striking force are forced to withdraw.

He is the last man to trail in a retreat, for he must delay the enemy. He destroys bridges and roads, and spreads his land mines, road blocks and tank traps. All of these projects on the battlefields are hurriedly built. Thus the engineer's job ranks in importance with that of the tank, whose power lies only in offense. The engineer must fight and build as effectively in the retreating action as in the offensive. His job is never done.



Amphibian engineers specialize in getting men ashore. With this and other types of landing craft they ferry men and equipment from ship to shore to establish a beachhead.

Chapter Nine

ENGINEER AMPHIBIAN COMMAND

IT IS NOT LONG PAST midnight. A cold, clammy mist clutches at soldiers dressed in tight, waterproof clothing. They are waiting for the zero hour somewhere off an enemy coast—tense-faced young men, shivering from the sharp cold and nerve-jangling excitement at the prospect of setting foot on strange territory. They do not know yet what they will have to face, but they are ready. There is no backing down now. At a command they crawl swiftly over the side and drop into the shallow-draft assault boats. Some of the boats are loaded with field guns, jeeps, mortars and tanks. These boats are larger than the swifter assault boats in which the men are jammed near the bow and huddle close to the floor.

They have rehearsed this same technique over and over; now they are putting it into practice. "It's the real McCoy," a private remarks quietly, trying to ease the tension with a smile and sardonic quip. The assault boats and heavier ferrying craft snake their way in and out among the screening force of destroyers and battleships. Once clear, the motors purr louder and they dart for shore.

This is the real thing all right—invasion! Crouching low in the boats, far out in front the men look like black dots in the rapidly approaching dawn. But it's still dark enough to afford some protection.

Then suddenly a rocket flare on shore streaks up through the black sky and bursts into a brilliant array of flaming colors. Orange, red and greenish tinted flares dart crazily about in the sky above. The

armada chugs on, weaving and zigzagging its way toward land. A big gun far back of the shore line roars and a shell screams out to sea, just skimming the air above the heads of those in the assault craft, narrowly missing a big bobbing barge-like boat crowded with a heavy tank and a crew of fighters.

Machine guns stutter in the darkness, shells whine and scream. The ground shudders as the battleships lay down a sheet of blazing shells a mile or two inshore. Suddenly the sky lights up again and half a dozen fighter planes scoot down across the shore line, raking the sand and the men tumbling out of assault boats. The boats have now dropped their bows to the sand, and tanks, armored cars and field pieces are rolling across the beach.

Assault squads of engineers were in the landing craft which first reached shore. They carried small satchels of explosives, and more engineers lugged bangalore torpedoes, grenades and heavy wire cutters. The engineers blast their way through the barbed-wire entanglements, and clear the road ahead for tanks. They surround pill boxes not far from the shore and blast them with flame throwers and grenades. The pill boxes are soon out of action.

Behind the engineers the artillery has mounted mortars and heavy field guns. They're hammering away over the engineers' heads, laying down a sheet of fire and flame out in front of the wave of engineers who are knifing a wedge through the area strewn with land mines. The engineers quickly clear a channel through the mined area, and the armored columns of tanks and motor vehicles stream through and fan out across the terrain.

This description is intended only to demonstrate the type of amphibious warfare in which the engineers act as one component of a team. Actually, in an invasion virtually every arm and service are represented and act a vital part. The function of the engineer is to make the way easier for the soldiers' advance, regardless of his branch of the fighting team. In the amphibious operation, the job of the engineer is to get the men from ship to shore and firmly

planted. Where the fighting progresses in an island group, his function may be to lay the carpet of advance from one island to another by means of boats and barges.

As the term implies, amphibious warfare means fighting on both land and water simultaneously, with the same troops. It is one of the phases of combat new to the U.S. Army. This brand of fighting has belonged traditionally to the Marines. Until the present war, the Army had been able to give a pretty good account of itself without taking to boats in any large force. In the past, during most of our military operations which necessitated the landing of troops on foreign soil, we had been fortunate in securing reasonable port facilities. But as time goes on, war and its tactics change. Development of aerial warfare and the increased speed of land fighting created complex problems in getting men ashore. Armies with tremendous offensive power no longer waited for a port to fall into their hands. They went ashore virtually when and where they pleased.

In many of the early invasions of foreign countries and islands in this war, transports frequently lay a mile or more off shore, while troops rolled over the side into fairly fast-moving landing craft. These big mobile landing boats and barges were heavily armed and could carry many men. In sufficient numbers they were able, in a few hours, to move thirty thousand troops or more from ships to shore. While troops moved toward land the transport could stand off shore out of range of coast artillery guns, thus rendering ineffective the old system of coast defense.

By the time the American forces were deeply involved in the present conflict the Axis armies had already gobbled up most of the strategically located ports. It was then the problem of our Army to devise a method of attack which would be effective without the favorable accommodations of ports and such facilities. Thus it was that the Army went to work in 1942 to meet the new demand.

Our Marine forces were not large enough to be split up and removed from other important operations for the purpose of getting

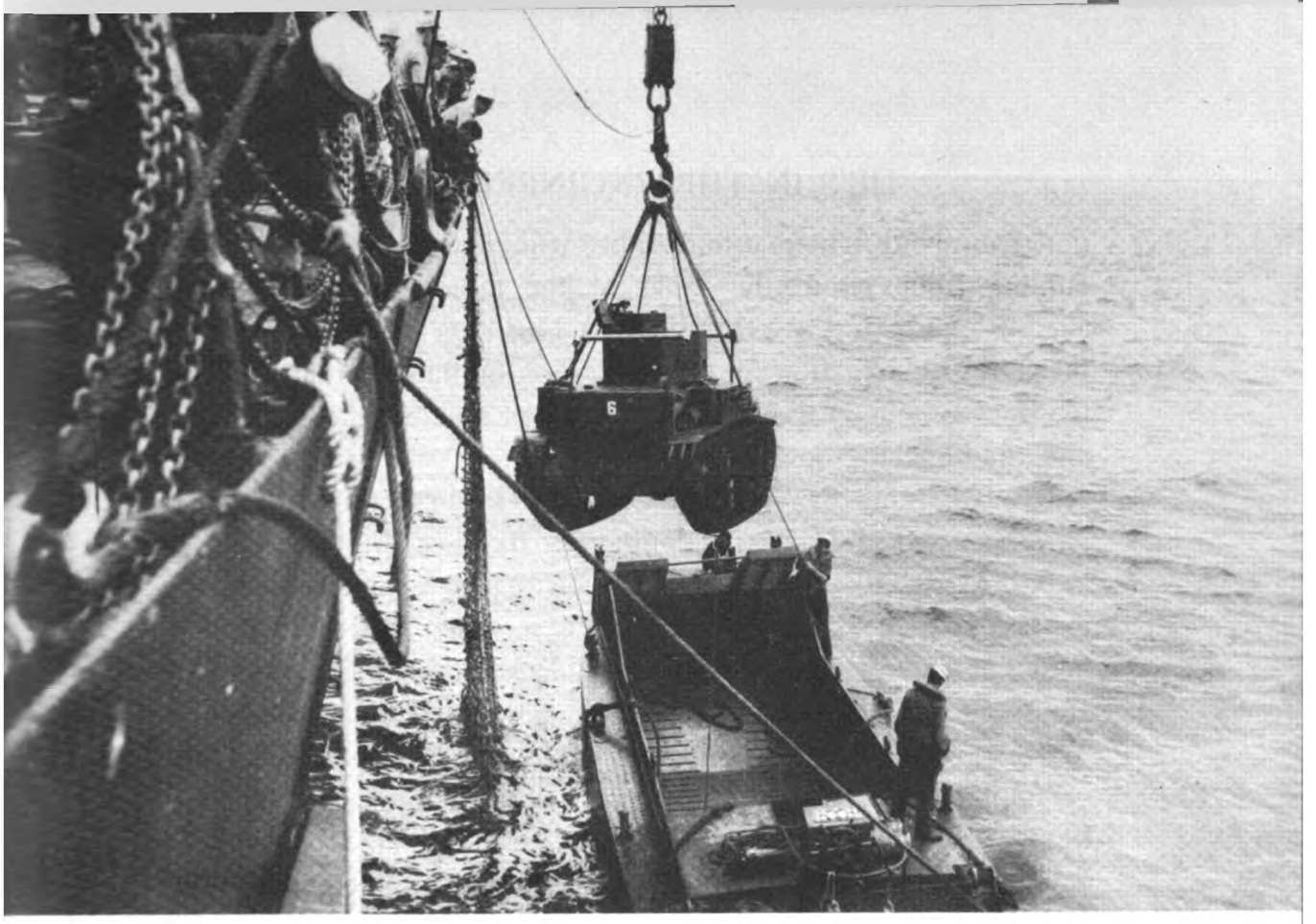
our Army land fighters ashore. The Army decided to mold its own landing troops from the ranks of the rapidly expanding force, already numbering several millions. This development for a time taxed the imagination and initiative of military leaders. But the Corps of Engineers was assigned the job of molding the new fighters and they buckled down.

It was natural that the engineers should inherit this chore. They have been crossing rivers in pontoon boats since the Civil War. In World War I they had added to their marine experience in many instances which demanded transporting men across rivers and inland bodies of water. But the engineers still lacked the land-water fighting ability and experience in boat handling which had been exclusive Marine property for so many years.

Amphibious warfare requires a type of training very different from that of troops schooled in strictly land fighting. Thus, with the decision to activate such a force in the Army, the immediate problem was to assemble a myriad collection of personnel with dozens of different types of experience easily adaptable to a combination form of land-sea fighting. The decision did not come until a few short months before the plans were made for the North African invasion.

Recruiting personnel demanded from the start a great deal of tact and diplomacy. Publicity was necessary to get the attention of men qualified to perform the many technical and semi-skilled jobs. How to put this Army story on the radio, in news columns and on the screen, without giving away some tip on our preparation for the North African invasion presented one of the most ticklish problems public relations experts of the Army had ever come across. Anyhow, the job had to be done, and there wasn't a lot of time in which to get the ball rolling.

The Corps of Engineers went to work. In a few days a bright little pamphlet was circulated at the War Department. Writers and correspondents who covered that beat received copies; other copies were mailed out to magazines and feature writers. An avalanche of



Planning and executing operations of this character is an engineer job. Here a tank is planted in a landing barge as easily as a crate of oranges. Once ashore the tank with others like it will be on their own. Amphibian engineers will return for another load.

requests for more information poured into the department. Radio sponsors and network producers wanted to visit the training center and originate programs telling the whole story of this new tool designed to get thousands of soldiers ashore, once they had been trained for the eventual task of fighting on foreign soil. Shortly afterward the pressure became so great for news and stories that the lid was clamped on by the Army, and very few stories got out about the Engineer Amphibian Command with any more information than was contained in that excitingly decorated pamphlet.

The pamphlet showed half a dozen pictures of troops jumping out of landing craft, heavily armed and making a dash for a shore. If an Axis spy had picked up one of these little publications, it certainly would have provided no aid nor comfort, for it simply told that the U.S. Army and the Engineers were girding for the real thing—a landing in Axis territory.

Incidentally, one interesting story of the amphibians told in that pamphlet was later enacted at Casablanca and Oran in almost exact detail.

"Young man," the pamphlet began, "you have been dreaming lately, haven't you, about doing something big for your country in this war? You really would like a chance for some dramatic action that would give you an outlet for your patriotic energy and at the same time throw an oversized monkey wrench into the plans of our nation's enemies?

"If you like the sea, its fogs, its heavy weather—if you thrill to the thought of handling a swift, powerful motorboat in the dark of night—if you are willing to take chances in striking hard blows at the enemy on his own soil—then just step inside the door of the nearest United States Army Recruiting and Induction Station.

"There you will find the key to adventure. The man at the desk will offer you an opportunity to become a member of the Army's 'Sea Taxis,' a contingent of the courageous young fighting men known as the Engineer Amphibian Command."

At top speed, men who were experts in more than forty different professions and skills related to the sea were hunted out by the Army. Many were transferred from other branches of the service where they had had experience to fit. Hundreds of volunteers from port cities answered the call, and many landlubber soldiers who had only read about the sea in books were drawn to the ranks of the Amphibian Command.

Although many others have been added since, the marine jobs the Army had to fill at the time included the following:

Able-bodied Seaman
Auto Repair Foreman
Blacksmith
Boatbuilder
Boatswain
Cable Splicer
Carburetor Specialist
Ship's Carpenter
Construction Supervisor
Cook
Coxswain
Crane Operator
Deckhand
Draftsman
Draftsman, Structural
Electrician
Electrician, Automotive
Engine Specialist
First Mate
Fisherman
Life Guard
Lithographer
Marine Electrician
Marine Mechanic
Mechanic, Automobile
Mechanic, Diesel
Mechanic, Master
Mechanic, Tractor
Motorboat Operator
Oiler
Oysterman
Painter
Plumber
Radio Operator
Radio Repairman
Rigger
Sheet Metal Worker
Signal Man
Surveyor
Welder
Yachtsman

It is an odd list, compared to the usual lists of trades and occupations enumerated for the other branches of the Army.

Gathering these experts, technicians and mechanics, indoctrinating them with basic military training, and getting them welded into a sea-mobile force in the short space of allotted time was one of the most zestful challenges the engineers had had to face in organization of the new Army.

A limited number of Army officers had studied and worked with various branches of the Marine Corps at their Marine training bases, where essentially the same warfare tactics were routine. But it was still difficult to collect enough officers to form the nucleus of the new Amphibian Command. The result was appointment of a reasonable number of experts in the handling of boats to commissions directly from civil life, but only enough to begin the training program which was to turn up some promising officer material of its own from the ranks.

The Amphibian "sea taxi" contingent of the Command is organized into regiments of two types—boat and shore and maintenance regiments. The boat regiments are the offensive units. Their mission is to carry the war to the enemy's shores. The shore and maintenance regiments keep equipment of the boat regiments in top-notch operating condition.

Although the two different regiments of the Command operate as a combined team under battle conditions, their training progresses in widely different subjects. Instructors are drawn from among enlisted and officer personnel who have had at least four years' experience in small-boat operation and maintenance.

Training for the boat regiments is crowded with all the thrills and excitement of what might be called a short course in speedboat racing, plus ample instruction in the use of machine and deck guns. The amphibians learn to hit a target while racing over pounding waves at breakneck speed. It is not easy to hit a target and maneuver a fast boat loaded with troops while it dashes and weaves about under a canopy of smoke, with machine-gun fire from a beach toward which

the boat is heading for a landing. But these are some of the more delicate tricks the amphibians master.

As the amphibian engineers wade through drills, coupled with the rudiments of hand-to-hand fighting, they manage to crowd in some academic studies that demand keen attention. They are such subjects as rules of the road at sea, or signs and signals of navigation. They learn nautical terms associated with parts and construction of boats. In technical navigation, they learn intricate maneuvering at close quarters and quick get-away technique. Through courses of instruction in signals, they learn the art of formation of boats in a column or squadron.

The curriculum also includes training in meteorology, which gives the recruit a feeling of inspired confidence when he has learned to observe with great accuracy the variations in weather, and to forecast with considerable expertness the weather to come. The new amphibian engineer comes to know about such things as tides and currents. He gets better acquainted with a compass than he ever dreamed he would. For the guiding finger of that same compass may point to the difference between the safe landing of his cargo at a secret spot on enemy shores or under a hail of hot lead and an inferno of destruction.

The amphibian engineer finds that maps and charts are among his trusted friends. He is fascinated by the curious symbols, dots, queer figures and oddly drawn lines that tell the story of coastlines, reefs, buoys, piers and such things. As an extra dash, the Army tosses in carefully prescribed quantities of instruction in official courtesy, salutes and nautical etiquette in general. The engineer becomes sailor as well as soldier.

Marked as one of the most important of the courses given the engineer sea soldier is piloting. Those who make the grade for this highly specialized niche in the Command are slated for a strenuous siege of "celestial navigation." This course is pure sailor stuff. It

means learning the use of a sextant and how to get about on friendly or foreign waters by following the sparkling finger of a star in the sky.

The course in piloting is thorough indeed. Before the amphibian pilot comes to the end of his pilot training he is an expert at position plotting, and can efficiently find his bearing at sea.

The task of the boat regiment pilots is to freight fighting men ashore where they can deliver surprise attacks. The power of this sort of an attack is the success with which the element of surprise is exercised. No guesswork is involved. Every movement, maneuver and operation of the boat or its regiment is calculated for accuracy and coordinated action. An effective attack and a safe landing may rest in the pilot's hands and on his skill.

Shore and maintenance regiments are divided into four segments, called echelons, each with a definite job to perform. Each component is staffed with personnel technically trained to carry out its particular duty. Drill and training in teamwork are highly important in this closely knit unit, and each man is instructed to that end regardless of the experience and skill he had in civilian life.

The first echelon of the shore and maintenance regiment sees that the boat and its motor, or motors, are ready for instant action when the landing signal is flashed. Personnel of this echelon includes the coxswain, who keeps an ear cocked for orders and maintains a continuous check on oil, gas, ignition and signal system, for the boat is expected to purr like a kitten when the order comes up for action.

Duties of the second echelon of the shore and maintenance regiment include taking the boat in tow when it has returned from its mission. The second echelon personnel scampers over the boat like mosquitoes when it dashes back to its base point, which may be on land or at the side of a transport off shore.

They inspect each working part of the steering, motor, electrical system, instruments and fuel system. They make minor mechanical repairs and adjustments in a matter of seconds. Second echelon personnel of the boat crews are usually located on stationary or floating

The tank rumbles down the gangway and plunges into the surf. This particular engineer operation is finished. When the tread touches sand, the tank is ready for action.

docks, or even on barges, all of which are equipped with hoisting cranes to snatch the boats out of the water if the situation requires such action.

With boats, as with trailers, trucks and heavy tanks, large working parts will often give under tremendous pressure or strain and come up with a dangerous breach at the most inopportune moment, whether it is in a practice maneuver or an actual battle. This is where the third echelon goes to work.

Jobs assigned to these amphibians are not easy tasks, and require a combination of hand, brain and husky back work. They perform the heavy repair assignments, like replacing propeller shafts or installations of complete new motor assemblies. Crews of the third echelon are also trained to perform these man-sized repair jobs on the flat top of a barge or stationary floating dock to the tune of pounding waves and none-too-gentle wind, if such weather prevails at the time a landing is in progress.

Equipment and training of the third echelon enable its personnel to do practically every type of repair short of a complete overhaul job which would require the facilities of a fully staffed shop and heavy mounted tools such as drills and lathes.

The fourth echelon is a mighty important part of this amphibian fighting machine. This echelon is not so likely to come under a hail of fire from shore, but upon its men rests the responsibility of completing a real marine engineering feat once a boat is placed in its hands. Personnel of the fourth echelon, like that of the other three, is staffed with experts of many different types, each a master of his trade.

When men of the fourth echelon get their hands on a boat they can rip it apart piece by piece and completely reassemble it in a matter of a very few hours. When a boat comes to them it immediately gets an expert inspection from stem to stern. Each bolt, screw and working mechanism is checked thoroughly from keel to bridge.

Shops of the fourth echelon are comparable to those of a large

commercial manufacturing concern. They are divided into special departments for the various types of repairs. Assembly lines are set up to carry a boat along, while repairs are made on perhaps a dozen boats simultaneously, as they move on the chain.

There is no doubt that once the war is over many former landlubbers now in the Amphibian Command will have become so salt-soaked in sea lore that they will stick to the business of building, designing and piloting these speedy craft which they have learned to handle so well.

Much of the equipment used by the Command cannot be described here, but it may prove to be the key to success of many a landing on enemy shores.

"Command boats," say the engineers, "are among the many interesting types of special equipment of the Command." They are high-speed, seaworthy craft, especially adapted for going to the rescue of other boats that might be disabled at sea. These Command boats, as well as those used for the transporting of large groups of men, guns and equipment ashore, are armored, and bristling for a fight at the drop of a hat.

In the event the Axis has not already learned from painful experience, all these boats, as well as the floating equipment that accompanies them, are protected by heavy arms and armor. All boats are fitted with special visual and signaling devices and radio receiving and sending equipment. They are water weapons designed to put the men across or land them on solid footing, and they do it extremely well.

By the use of landing mats aviation engineers build an airfield in a matter of hours. Here an engineer levels a corner on one of these amazing metal strips which have enabled the Air Force to operate from remote sections of the globe.

Chapter Ten

AVIATION ENGINEERS

EARLY ON THE MORNING of November 8, 1942, airborne aviation engineers, mounted on light reconnaissance trucks, jeeps, pint-sized bulldozers, rollers and tractors, were racing across nearly eight miles of North African shore. Shells screamed wildly across the sky. Occasionally a bomb shook the ground like an earthquake. The engineers streaked along over the battle-scarred shoreline, headed toward an enemy airdrome which had just been captured by our own paratroopers. Needless to say, they arrived at top speed.

This new military unit had made its debut in Africa without a hitch. It caused some eyebrow-lifting among officers already ashore; all of them hadn't heard about the airborne engineers. News of the airborne engineer operation circled the globe. Grimy, mud-soaked soldiers in the front lines, from Alaska to Guadalcanal and from Panama to Cairo, smiled at this news. This was the extra leg to stand on that Lieutenant General Henry H. Arnold, the Chief of our Army Air Forces, had said we needed.

Commanding generals in nearly all theaters of action had, since 1940, been languishing in a military stew for engineers to get into the jungles and desert. They wanted machines and men who could be dropped down in advanced positions to build airports for bombers and supporting fighter craft. The Air Forces were getting a steady stream of fighting craft from the assembly lines and pilots from training centers, but many of our generals were handicapped because of the long distances that bombers and fighters had to fly to reach

a point from which they could operate effectively with ground troops. General Arnold knew these gallant air warriors of his would do plenty of damage, once they got within reasonable striking distance of the enemy. His Chief of Engineers was then Colonel Stuart C. Godfrey, now Brigadier General. Godfrey is possessed of an ample share of imagination and ruthless determination.

Godfrey undoubtedly recalled the gold hunters and adventurous oil scouts who had been flown with their mining equipment into South America in peacetime. He must have studied carefully the experiences of flyers like veteran Joe Crosson up in Alaska, who had for years been flying everything from milch cows to turbo-generators into the wilds of the Far North for prospectors searching for precious minerals.

General Godfrey called a huddle of 14-karat engineer minds of the Corps of Engineers. They went to work to thrash out some ideas on types of equipment and the methods necessary to get it transported by air. There was no exact precedent or plan for this machinery. Led by a brilliant young engineer officer, Major H. G. Woodbury, the group went to work. They drew up specifications and searched the country over for models. It had to be machinery that could be virtually tossed in and out of a giant plane, and still be heavy enough to do a regular man-sized construction job.

Plans of this new outfit called for miniature tractors, rollers, bulldozers and even portable generating equipment, which could be delivered by plane, and then set up by a very few men. The generating equipment had to be small and at the same time powerful enough to wind up sufficient electricity to light up an airport.

Manufacturers must have thought the Army engineers had become a bunch of fly-by-night promoters led by insane Rube Goldbergs when the engineers ordered hundreds of these new pieces of machinery. None of them was to be much larger than a good-sized baby carriage. But the production lines tooled up and started whirring off these tiny instruments of war.

Before a single piece of this new equipment could be completed, the airborne engineers were ordered to an embarkation port from which they would sail for Africa.

Meanwhile, Major Woodbury was named commander of the first provisional brigade of airborne engineers. He was working fast too. When the engineers started for the embarkation point he was getting plans set. The engineers arrived ready to sail. Then the first batch of equipment came off assembly lines. There wasn't time enough to ship the stuff by train in the usual manner. So a fleet of transport planes landed at the factories, opened their doors, and the equipment was getting its first practical test in a war operation as it was shoved aboard. It was rolled right into the planes and flown immediately to the port of embarkation to join troops who would use it in the landing.

Troops who were to handle this equipment on the other side were given much instruction on the boat, as they crossed the Atlantic. All of them were hand-picked. They were all skilled in piloting the heavier types of bulldozers, carry-alls, slip-scrapers and rollers. Many a joke was cracked aboard ship about the new pint-sized buggies which on the surface looked more practical as pill mashers or tennis court brushes. However, joking aside, the troops took to them like the proverbial duck to water. At once a new pride sparkled in the airborne engineer ranks.

And then at dawn on the morning of November 8, just south of Casablanca and Morocco, these miniature land builder-fighters tumbled out of the bows of landing boats and wobbled, rolled and bucked ashore. Eyes popped in the ranks of other engineers with the ground forces who hadn't seen this new kiddie-car version of the slip-scraper, bulldozer and other ground-leveling devices in action. Across the nearly eight miles of land these machine-age bugs skipped toward the airport which paratroopers radioed back was in Allied hands after a terrific pounding by enemy aircraft.

The new airborne engineers came onto the scene with clocklike

precision, hooked onto wrecked planes, dragged them off the field, snatched piles of dirt and filled shell holes, and then leveled out runways in record jig time. The engineers worked like mad, with rifles slung over their shoulders. Paratroopers were holding the fort. Under protection of their brother airborne fighters, the engineers threw together the working parts of their portable generators and strung out wires that tied up the airport illumination system, which had been badly mangled by bombing and shell fire. In almost less time than it takes to describe the operation, the engineers had the field set to accommodate units of our air force fighting in that area.

Hardly had the airborne engineers gathered up their tools when a fleet of C-47 transports landed on the field. Fighting was in progress further down the line, and more airfields were waiting for the magic touch of the engineers. The C-47's had landed with an order from Major General Jimmy Doolittle, then Brigadier General, for the engineers to load up their baby bulldozers, scrapers and tools and get going. So as history unreeled, the tiny one-man machines crept aboard ramps and crawled up through gaping doors of giant C-47's. Motors roared and the unit took off for high adventure and more precious construction work that was to lay the carpet for the Allied Air Force advance.

Undoubtedly, the airborne engineers are giving the Axis some nightmarish sleep. For their tasks are now being carried out in theaters of action around the world. These engineers are giving the air force a foundation upon which to pyramid their attacks on the enemy.

Personnel, for the most part, are volunteers. They are carefully chosen for physical ruggedness and individual skill in handling the peacetime tools converted into small but lethal weapons. Each man who chooses to become an airborne engineer must submit to one of the most rigid of physical examinations. His job calls for the coolest daring and a physique that will stand considerable strain, whether in the air, or moving up with advance forces on the ground. His unit is

designed to be the spearhead of any kind of offensive called for by the air force. Each man, by the very design of the organization, must be a specialist on some piece of machinery. Since it is transported by air, every piece is designed to occupy just so much space in a plane.

Each man must be a specialist because the machinery, although ruggedly built, requires expert handling. Every foot of space in a transport has to be accounted for when the unit moves, and there is little room for spare parts that might be required if the machinery were handled by green hands.

Each of the fighting engineers is also a trained combat soldier, for he works under conditions almost identical to those under which the paratrooper works. And in most instances he is working side by side with the paratrooper, once they are both on the ground, in the vicinity of an airdrome well up in frontal sectors of combat. He is trained to meet nearly any conceivable emergency, and therefore is one of the most versatile of our fighting men.

Official statements released by the War Department explain that the firepower of a single company of airborne engineers is deadly. Each private carries an MI rifle, each corporal a Thompson sub-machine gun, each officer carries a carbine, and each sergeant is armed with an 03 rifle and an anti-tank grenade. Even the clerks of the outfit are trained, armed and ready to fly or fight along with the fighter-machine operators. These engineers can work with one hand on a machine's throttle and the other hand on a gun while the trigger finger itches.

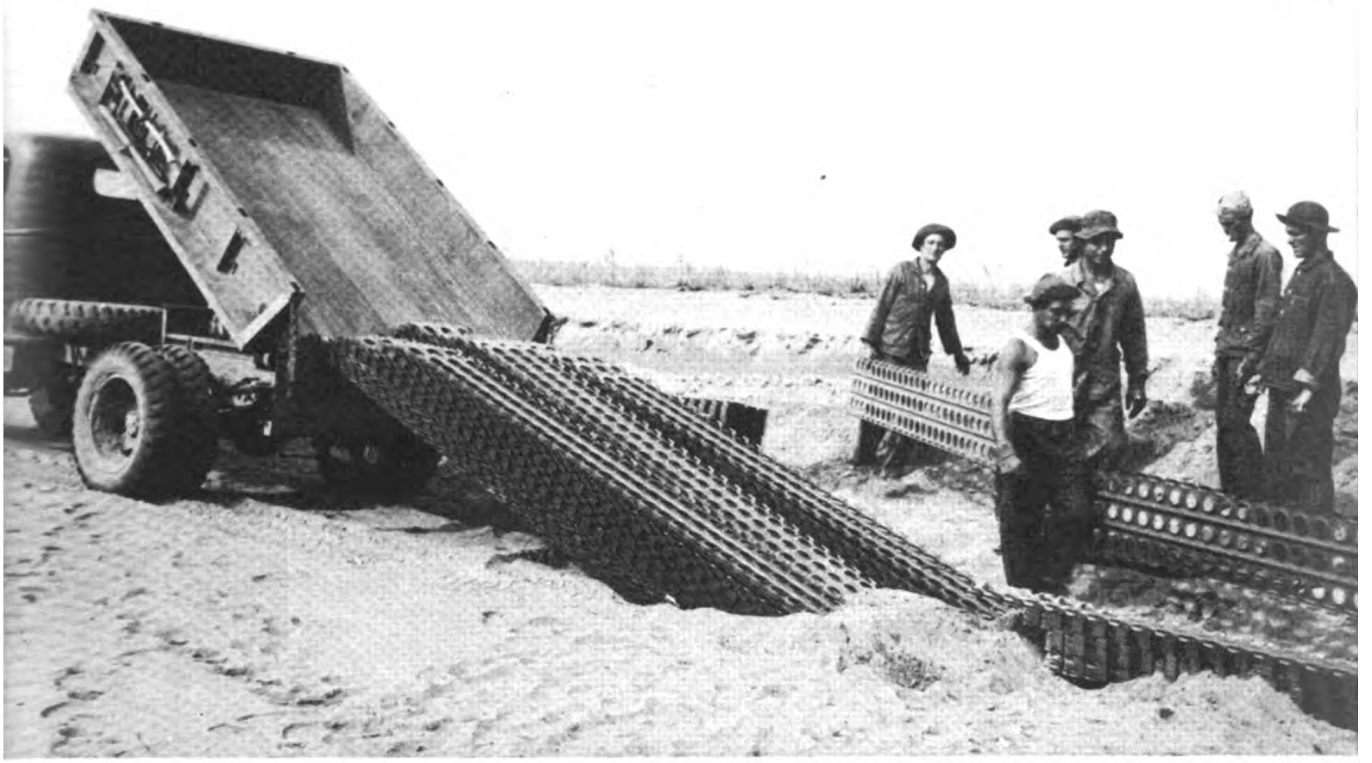
When men of an airborne unit reach an air base to join the air force command, ready for operation, they have already completed basic combat training and practical engineer training. Once at the air base, they immediately begin learning about the business of riding the flying freighters that will transport them and their precious cargo of miniature equipment. About the second day after arrival at the base, the airborne engineers, who prior to this time have been green to the air, are piled into one of the big C-47 transports. Off

they go on test hop number one. The big ship swings in breath-taking dips, dives, turns and banks. It hedge-hops from field to field and may even skim the first coat of paint off the roofs of a few scattered buildings just to give the boys a thrill. However, it is a thrill with a motive. It is designed to test the nerve and air-adaptability of these engineers who will be depended on later to ride many a transport under all kinds of conditions, battle and otherwise. Just prior to the first take-off each man is provided with a small cardboard cup or box which will prevent him from spoiling the plane's interior if he should suddenly suffer an attack of air sickness.

After the first hop, the engineers are given a breather for a few days to go over academic studies connected with the new job. As the new engineers get over the first excitement and begin to get the feel of being around the big transports, and learn something of the vernacular of airmen, they take to the air once more on a second test hop. This time they get the works. The pilot tosses the big ship through every page in his book. It does everything in the air but come apart. Its engineer cargo gets a good dose of "maneuvers" uncorked at all altitudes. When they come down it is not difficult to weed out the engineers who have decided that a flying engineer's job is not all it's cracked up to be.

Then, with a crew of airworthy men set to go to work, the airborne engineer outfit gets down to business. They begin learning all there is to know about operating the equipment they will use to build or repair airports. They learn how to load and unload the tiny bull-dozers, scrapers and power tools. More mechanical training on repair and maintenance of the bug-like machines is mixed with additional time in the air as training progresses.

Then comes graduation time. The engineers scramble into the giant transports with their equipment, and off they go to a spot remote from the nearest landing field. Often a place far off in some mountainous region may be the destination. The pilot lands the



Spreading these landing mats to build an airfield is a well-planned, smoothly efficient operation. When a field is no longer of value to the Air Force the mats may be removed and re-laid at a new location.

plane in some tough spot with considerable jolting up of the engineer crew. They hop out of the plane with orders to peel off a strip of ground and level it up in a hurry, so the pilot can get back into the air. This is hard practical training done under watchful eyes and precisely timed. The process is repeated until the engineers are entitled to call themselves real airborne engineers. The training of the airborne engineers is as rigorous as any in the Army. Every man, from company commander down to private, goes through a daily drill period of calisthenics and exercises calculated to make the men as hard as nails. The principal feature is the long obstacle course over which they climb, crawl, roll, jump, hurdle and swing by hand and foot.

As the men reach the end of the training period they are soldiers on the ground as well as in the air. They can load their buzzing little dirt snatchers and mechanical bugs into one of the C-47's quicker than you can back your car from the garage. They can unload as quickly, and can make an airfield out of almost any piece of ground that can be run, walked or crawled over. During the training period the airborne engineers have mastered the art of getting their equipment into big gliders as well as into transports. And they can ride with their equipment to a glider landing, which isn't a joy ride for such a heavily loaded craft without power to soften the contact with mother earth. They add to their versatility by learning to load their equipment into assault boats and get it ashore under fire, as was done in Africa.

The airborne engineers are also equipped to reinforce regular aviation engineer battalions with the ground forces in the construction of roads, clearing of mine fields, installation of power units and utility systems, and lastly to de-contaminate gassed areas if necessary.

All of this they can do with the cool, calculated finesse of the finest soldier, and yet they can fight like—well, as one officer put it, "I'll stack 'em up against any outfit in this man's army." And he

meant it. To morale crusaders the airborne engineers say they don't need any. They've got the "spirit." That's twice as good.

The airborne engineers grew out of the old aviation regiment of engineers. Forerunner of the present aviation engineer battalion and airborne battalion was the 21st Aviation Regiment organized at Langley Field, Virginia, in 1940.

The Army found that a regiment, numbering more than 1300 men, was too large and unwieldy an organization to fit in with the streamlining process the Army was effecting. So the regiment was soon abandoned and the primary operating unit became the battalion, which has little more than half the number of men formerly assigned to a regiment. In today's Army the regular aviation engineer battalion is the stand-by of the air force. Their mission is to construct, maintain, camouflage and defend airdromes. The job of the airborne engineers is a lighter task. As has been explained, the airborne units make up the advance emergency fighting-builder force.

Once they have serviced an airdrome, the regular aviation battalion moves up behind with ground forces with much heavier equipment. They then make permanent the installations which have been marshaled by airborne engineers.

Although troops of these battalions belong to the Corps of Engineers, they are under direct supervision of the air force headquarters of the unit to which they are assigned.

Argument over which is more important—the mechanics and pilots who keep the planes flying, or the aviation engineers who provide and maintain the landing field—is rather pointless. A pilot can talk about the prowess of his fighter or bomber, but the engineer comes right back and says, "Well, you gotta have some place to set the darned thing down!"

Equipment of the aviation engineers isn't the kind they'd write home about. But it gets priority number one when the squadron moves. It includes motorized air compressors with air tools, road

graders, carry-alls, scrapers, trencher, tractor, cranes, rollers, plows, gasoline shovels, road material mixers, and tractors with bulldozers. Hand tools consist mainly of carpenter, demolition and miscellaneous items.

The battalion is completely motorized to move under its own power. Common equipment for this outfit is the command or pickup truck, light trailers, light dump trucks, and cargo trucks and trailers for carrying heavy machinery, and pontoon equipment.

Like all other engineer soldiers, the aviation engineer gets basic military training which makes him competent to hold his own with any combat soldier under fire. He is proud of the fact that he's a soldier as well as a builder.

As this is written, reports from the Far East tell of the valiant fight the engineers are making to carve out airports for our air fighters. The engineers have had to hack their way through an isolated strip over the Owen Stanley Range. They are shadow boxing with death as they carry on.

A battalion is strung out across a kunai grass field. The green grass is shoulder high, and stifling hot. There is a rhythmic swaying movement as the men's arms reach up and then drop mechanically from view. They are stripped to the waist, and sweat trickles down in rivulets from tense brows and bent backs. The pressing heat is grilling, but the sheaves of green grass fall steadily before the onward-moving engineers. Suddenly, at the sound of an approaching hum, someone shouts, "Zeros!"

The hum turns to a snarling roar. The men dive to a prone position, hugging close to the ground. One Zero, then another, darts over the field at lightning speed. Jap pilots know the engineers are there, but they can't see them. Seconds pass, and the Zeros disappear in a hail of anti-aircraft fire from a position near the field. They are gone, but not without sprinkling the tall grass well with a spray of tracers.

The engineers rise to their feet and once more slash into the tall grass. They have scythes now but they started the job with bayonets.

On through this infested jungle country, driving ahead under gunfire and bombing, the engineers are building airports. The Japs never believed that Americans could work in this climate, but the Japs didn't know our engineers. The aviation engineers are not confining their operations to those against Japs alone. They are found in dozens of other areas—at stations separated by thousand-mile gaps in some instances, and in others strung along a few miles apart, like links of a chain.

Whenever possible, aviation engineers are picked from enlisted men who have been specialists in civilian highway, paving or airport construction work. When such men can't be found, the Army simply takes the men who have had experience in certain types of work which makes them readily adaptable to the work of an engineer.

There are few aviation engineer duties that do not come under the heading of hard work. Each battalion is normally equipped with a topographical company and a water supply company. The water supply company, so far, has been one of the most important in operations in the Far East and other remote outposts.

In a fever-ridden jungle the engineers must find a source of supply, then set up and operate a purifying unit. If water is scarce, a pint of it may become a precious factor in the fight for self-preservation, along with the fight against the enemy. It may be necessary to ration it to a few ounces a day. Men cannot fight without water, and in a steaming jungle or hot desert it ranks in importance with food. Thus the duties of the engineer in the water supply company become as important as that of the medical officer or the quartermaster.

The topographical engineer, whose story is told in another chapter, performs a vitally essential job, cutting through jungles to get bearings and information on which to base the revealing lines of his maps. However, his job is often made easier by the use of aerial photographs made on reconnaissance flights by the air force.

The aviation engineer's versatility does not demonstrate itself vividly until he gets into a combat area. Then routine jobs, such as

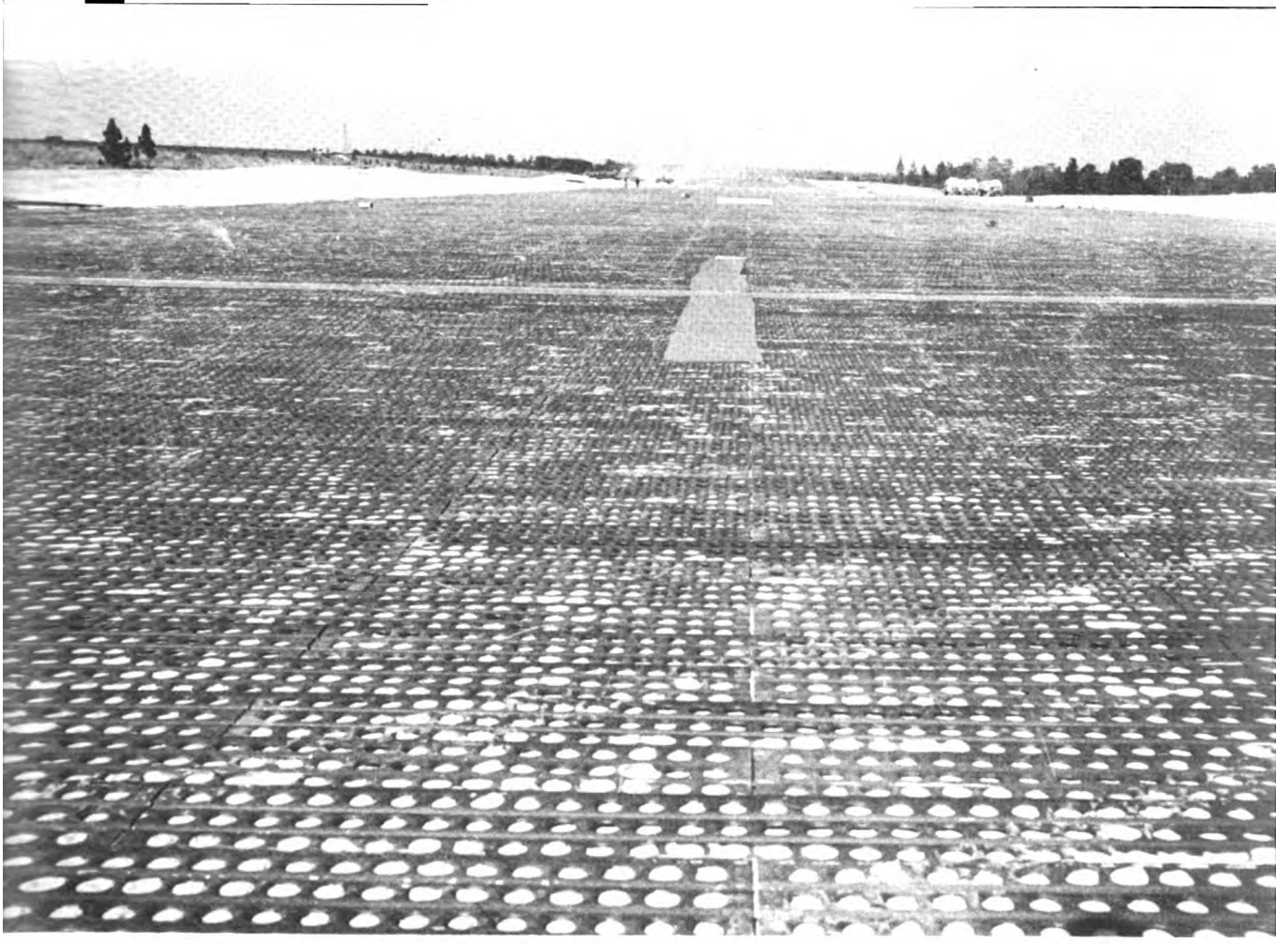
construction of living quarters, temporary repair shops, ammunitions dumps and so on under fire take on a heroic hue. Under enemy fire or bombardment, these duties cannot be tossed off lightly.

Pilots and air force personnel take their hats off to the engineers when it comes to camouflage. This is one of their specialties. Although they may not always do the actual work of camouflaging, they direct the work and see that it is properly accomplished. Without some effort to fool the enemy, an airfield spread out like the Monday morning wash in this modern war is wide open to assault or air attack.

The engineers start thinking of camouflage even before the airport site is selected. When they are assigned to conceal an airport which may encompass a hundred or more acres, their imagination is in for a good stretch of work.

The camouflage they do depends on the location. Natural surroundings with plenty of trees and foliage simplify the task somewhat. But without nature's help, camouflaging assumes complicated proportions. Tricks pulled from the engineer's hat sometimes include construction of dummy silos, barns and houses; and at other times they may even build a small fleet of dummy planes to be dispersed about a field to make the enemy waste his bombs and frustrate his effort to locate the real planes hidden away elsewhere on the ground. The engineers will also paint trees, trails and roads on a runway, blending the earth strips into the terrain with the greatest skill.

Defending the airfield also means setting up defenses against possible ground attacks by armored forces, parachutists and airborne troops. To carry out this mission, the engineers construct road blocks and spread land mines on roads approaching the air base to halt tanks, and build pill boxes for defense against paratroops. Since the engineers carry much heavy equipment with them, they can, if necessary, scatter their fleet of trucks, bulldozers, cranes and other gigantic mobile units around the field, making it impossible for airborne troop carriers to reach the ground.



A completed landing strip ready to accommodate a flying single-engined jeep or a giant four-motored cargo plane or bomber.

Of all the ingenious devices developed for the air forces, the landing mat ranks highest. In the present fast-moving mobile war, there is seldom time enough to construct an airport in the prescribed manner, using carefully mixed concrete and other materials. The landing mat is solving this emergency problem. The typical landing mat can be laid in a matter of a few hours by an engineer crew. Normally it consists of several thousand linked metal plates.

To put the mats down, the engineers pick a fairly level spot; if it isn't level, heavy equipment can be cranked up and pushed into action. The scrapers, bulldozers and shovels make the dirt fly in short order. Then, with the ground level, the spreading of the mat is a rapid-fire mechanical operation. Once down, it accommodates any type of plane from a 65-horsepower flying jeep to a four-engined troop carrier. The metal mats also lend themselves well to the camoufleurs. Appropriately spread dashes of paint can make one of them look like a polo ground, or a stretch of finest grazing pasture.

One beauty of the portable landing mat is that it can be dismantled and moved to a new location once a field is no longer of value as a strategic operating point.

Landing fields now being hammered out in war-torn strips around the earth by these pioneer aviation engineers will one day, perhaps, be stations on the aerial counterpart of the covered-wagon trail, stretching around the circumference of the globe.

Chapter Eleven

CAMOUFLAGE

KAY FRANCIS, THE MOVIE actress, is reported to have said to one of her male acquaintances who was her dress designer, "I was so surprised to read that you are going into the camouflage division!" The dress designer's reply is supposed to have been, "Why should you be surprised? I've been camouflaging you for years!"

Whether the actress actually made such a comment has no point here other than the fact that clothes are camouflage. They hide the bare skin, and in some instances clothes make us look like something we are not. That, in effect, is what camouflage does for the Army. It makes guns, tanks, planes, barracks, airfields and so on look like something other than guns, tanks, planes, barracks and airfields. In other words, camouflage hides the bare skin of the fighting forces. It may be the skin of a fleet of tanks, a military installation, a coast artillery gun, or any number of other things. It blends the article of war into the setting of which it happens to be a part.

Camouflage has often been called the art of concealment. But it is also known as the art of deception, the art of self-preservation, and the art of fooling the enemy. Not long ago a congressman in Washington climbed to the roof of the House Office Building, adjoining the Capitol. He found a wooden gun on top of the building. From a distance the wooden gun had all of the marks of a real anti-aircraft gun. It was even fitted out with a dummy scarecrow representing a soldier, down to regulation hat and raincoat to withstand the Washington weather.

This particular congressman, displaying a wealth of misinformation in regard to military strategy, let it be known to reporters that he had discovered a hideous weakness in the Capitol's armed defense system. "What was the Army doing planting wooden guns on top of the most precious structure in Washington?" he wanted to know.

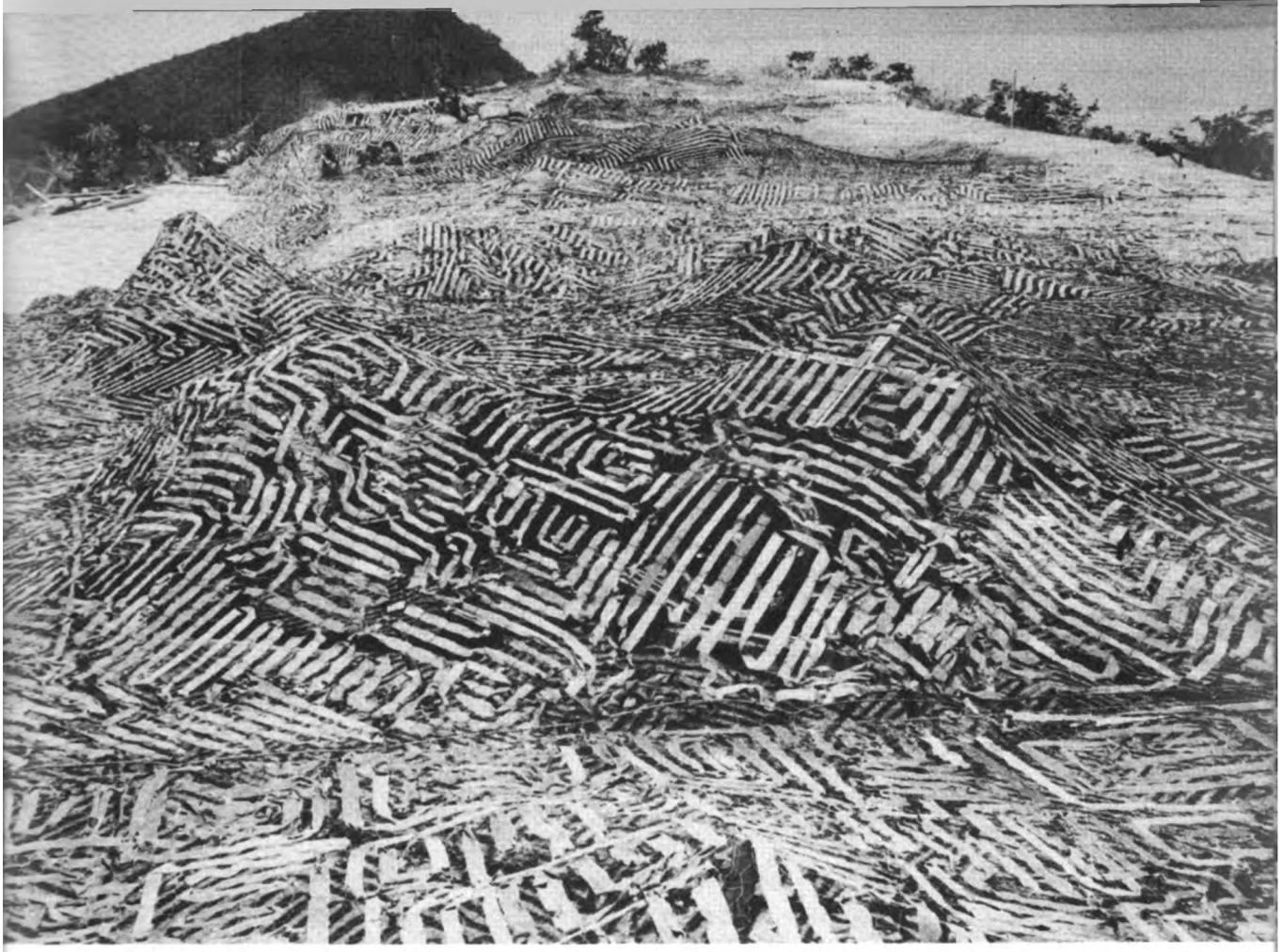
The truth of the matter was that the Army knew very well what it was doing. The dummy gun was there as a part of a cleverly devised camouflage system. Certainly, if the congressman didn't know how many guns were planted around over the city—and there are plenty—how could the enemy know? The congressman could have counted all of them perhaps, if he had had the instinct of a detective and the yen to know the facts. But even then, he wouldn't have known how many were real and how many were wooden!

Camouflage as an art, if it can be called that, is a potent factor on every battle front of the world. From the jungles of Panama to the storm-beaten tracks of the Aleutians, and from the wilds of New Guinea to the sands that line the Suez Canal, fighting men conjure up every conceivable device the imagination can command to utilize camouflage as a protective measure.

Gun emplacements, tanks, airdromes and trucks are camouflaged. The soldier's uniform itself is carefully matched in color to the terrain over which he fights. Far behind the lines in our own country the camoufleur has added his magic touch. Last year a group of officers and dignitaries were flying to an airfield being used during maneuvers. The field was so cleverly camouflaged they couldn't locate it before running out of gas, and were forced to make an embarrassed and somewhat upsetting landing, which included ripping down a fence or two. The troops had done an excellent job.

It is not difficult for any citizen who lives along either of our sea coasts to note the industrious zeal with which camouflage has been put to the task. It is the curtain designed to fool enemy eyes, both on the ground and in the air.

Colonel Homer Saint-Gaudens is chief of the Army's camouflage



This carefully woven camouflage strip might easily hide a ferocious Coast Artillery gun or a fleet of fighter planes. An aerial photographer would have to look long and hard to untangle the photographic puzzle.

section, and he will have the engineer soldier know from the start that his specialty is no easy job. The rapid development of the aerial camera along with the airplane itself accounts for the weighty importance of camouflage. The highly developed aerial camera reaches with an uncanny eye into virtually every crevice, nook and corner of the terrain it catches in the focus. From the photograph maps are made. And from the maps the bomber pilot plots his objectives. Thus camouflage and keeping bombs away from the soldier go hand in hand.

Every soldier in the Army is required to know the fundamentals of camouflage, although the engineer soldier is the specialist in this field. The engineer soldier does not do the camouflaging for all troops, but he sees to it that the rules of camouflage are carried out. The only camouflaging the engineer actually does himself is that done to protect the installations of his own unit.

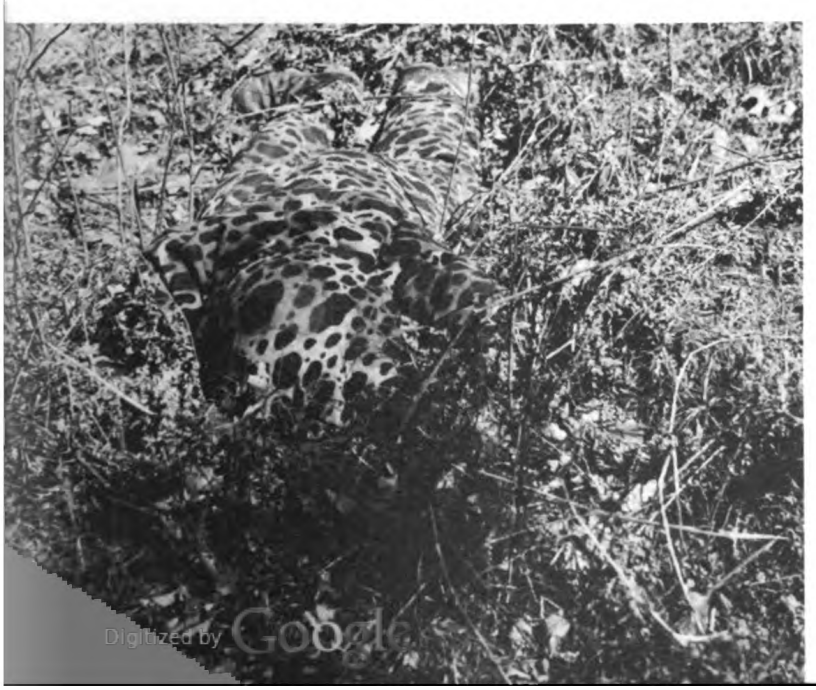
The primary work of engineer camouflage units throughout the Army is inspection, discipline, training, planning, experimentation, manufacture and supply.

The list of specialists and skilled technicians required to make up these units is odd, compared to other elements of the armed forces. Among the specialists are men who have been associated with motion picture and theatrical art departments, such as art directors, property men, model builders, scenery builders and special effects men. Also included are painters, mechanics, riggers and carpenters. If this collection of experts and specialists were all paid civilian wages for their advice, their work and their skills, they probably would constitute the highest-paid group of experts in the world, outside of the same number of motion picture stars themselves. However, the Army recognizes the expertness of this duty and one is not likely to find a camouflage man in the enlisted ranks below the rank of sergeant. An expert camoufleur has a peculiar combination of artistic talent, daring imagination, rugged individualism and square-jawed patience.

The *Engineer's Field Manual* says, "In view of the nature of the

Above: All soldiers are taught the rudiments of camouflage. This soldier is camouflaged up to the ears. Note the war paint on his face that blends with the spotted helmet and uniform.

Below: Camouflage is another engineer specialty. Engineers develop the technique and teach other soldiers the art. It is difficult to distinguish this soldier's battle dress from nature's carpet. It would take sharp eyes to detect his hiding place.



work on which units are employed it is essential that personnel be recruited from men trained in civil life along lines of work expected of them in military service." Thus, at Fort Belvoir alone, there are enough of these artists, technicians and experts, working, planning, scheming and devising methods of fooling the enemy, to snap into ranks and shoot a complete motion picture should such a thing be wanted.

It takes a great many of these experts to see that all of our troops and equipment are properly hidden at all times from enemy eyes. Therefore many have to be trained. That is the engineer's job too.

When a soldier with appropriate talents and inclination is found and placed in the engineer training unit to specialize in camouflage, he learns first to build devices used in camouflage operations. This in itself may require a knowledge of both painting and carpentry. He must know how to build a framework of a dummy airplane, how to cover it and with what type of material, and how and with what colors to paint it. He must know how to tie garlands of colored cloth onto a fish net to make it resemble foilage. In addition, he is taught how to manufacture certain types of materials needed on his job. He must learn how to interpret aerial photographs with reference to visibility of camouflage from the air and detection of camouflaged enemy activities. This is a game played by both sides, and the engineer must have the answers at his fingertips when he's consulted on a phase of a certain aerial photograph of specific enemy installations. Since he is a specialist, he is more likely to know what the enemy will do to cover up his guns, planes, men and tanks.

The smart commander rings in a camouflage engineer officer before he chooses a site for an installation or bivouac. He knows that the camouflaging has to be planned before, not after, troops are concentrated with their equipment. Thus the camouflage officer may be the one who decides where and how an entire division may be dispersed or bivouaced for the day, night or week.

Here a cleverly stretched camouflage net protects the crew of a French 75 mm gun ready for action. Enemy airmen have difficulty locating such targets.

There are two types of camouflage battalions. One is called Army; the other is known as the GHQ camouflage battalion. The Army battalion includes a headquarters, a headquarters and service company, and four lettered companies. Each company normally would include four platoons of fourteen men each, with one officer assigned to each platoon. Since any one of the platoons may be called out on a special mission requiring a reasonable cross-country journey, the battalion is motorized, but not heavily armed.

The GHQ battalion performs essentially the same jobs as the Army battalion companies. However, it is equipped with a "shop company," which can manufacture camouflage materials such as screens, nets, frames and so on. Once they have completed the manufacture of the required materials for the camouflaging of a certain unit, the materials are usually handed over to the troops of that unit. The work then progresses under the supervision of the engineer camoufleur assigned to the unit, or an engineer detached from another unit for this special task.

Some idea of the versatility of the camouflage engineer may be gained by a look at his organization and equipment. The platoon is commanded by a commissioned officer. It includes technical supervisors and command personnel, overseers for detached sections of the platoon, camoufleurs, general carpenters, painters, and chauffeurs for platoon transportation.

Equipment of the platoon includes a camouflage set. In the set are such items as hand tools and paint-spraying machine. The platoon also carries a small quantity of camouflage materials—items like wire, rope, osnaburg, cotton cloth, nets, stakes, paints and so forth. If an officer on an inspection of a base's camouflage set-up needs a conveyance other than that of his unit, such as a motorcycle or pickup truck, he calls one of the higher echelons.

Even though the camouflage unit is lightly armed, its personnel is trained to protect itself and can do so with small arms. In a combat zone the job takes on an uncomfortable aura of danger. In actual

Imagination gets free rein when engineers start camouflaging. This ingenious pile of boxes, easily mistaken for a city's backyard, could conceal a sizable contingent of troops.

operations, the platoon is the basic operating unit. Although major camouflage projects for installations common to all arms are normally executed by general engineer troops, the plan for such jobs is prepared by the camouflage unit or approved by the unit camouflage officer. Minor tasks of camouflage common to all arms may be executed by camouflage troops. Normal duties of the platoon, however, are to give assistance by means of demonstration and instruction to troops occupying an area, and to plan general or special camouflage installations.

A platoon can cover an area of from ten to fifty square miles, depending upon the road net and the area over which the installations may be dispersed. Members of the platoon travel through their assigned areas, observe the state of camouflage, give advice, make suggestions and, in general, act in an advisory capacity.

The GHQ camouflage battalion's job is mainly one of manufacturing large amounts of material to be distributed among the various army installations. It forms the nucleus for organization of large camouflage factories and depots; carries on experiments and searches for new methods. It is a highly trained organization and has in its ranks many technicians of a professional calibre. The work of this unit even reaches into the laboratory, where the scientist or chemist tests and experiments with various types of cloth, paints and many other materials which are the foundation of camouflage.

Before December 7, 1941, a single officer was assigned the responsibility for camouflage development throughout the entire Army. The day after Pearl Harbor, hell popped. Telephones in Washington virtually jumped off the hooks. Air base commanders wanted none of the blasting done at Pearl Harbor, where barracks, quarters, offices and hangars and runways were spread out like a bull's-eye. They wanted protection. They wanted some form of camouflage that would at least confuse one bombardier on his death mission. As with the rest of the Army, camouflage took on a personality of its own

immediately. It expanded. Now there are thousands of soldiers trained in this vital art.

The engineers practice several different methods in doing their camouflage work. One is complete concealment, accomplished by stretching a camouflage net in a lateral position directly above the object to be hidden. Another method is deception. The engineer calls this "making the object seem what it isn't." For instance, fleets of dummy planes may be built and dispersed within view of the aerial observer. It costs a few dollars to build one and it may cause the enemy pilot to throw away a bomb that costs thousands, and what is more important, miss the real target. Still another method is termed "blending." In this instance, the side and roof of a hangar may be painted a wild, weird assortment of fantastic colors. Such a hangar would probably be located in an area of hills and jagged terrain. The effect of the color would be to blend the hangar into the landscape. Close up, a building camouflaged in this fashion looks like something out of Dante's inferno. There are three things the camoufleur keeps in mind. They are to hide his objective from ground observation, air observation and the eye of the aerial camera. The methods of camouflage vary with the geographical location. In Alaska the engineer camoufleur deals with snow. At times his job may be simple, but if he's located where snow melts at a certain time of the year, then begins a constant battle with the weather to keep his installation under cover. On the desert in Africa, for example, extreme difficulty was experienced by the British in hiding their tanks and armored forces until they learned something of the correct camouflage methods. It is not easy to hide ten thousand or so troops and their equipment at the drop of a hat. It takes both skill and planning.

Much has been written about the Jap camouflage tactics in the Solomons and New Guinea. There the Japs painted themselves all sorts of fantastic colors to blend with the foliage. Then they climbed

trees, lashed themselves to the trees, and hung like invisible monkeys, taking potshots at our troops, who at first had great difficulty hunting them out. The Japs even went further than color. They camouflaged sound. They went into the jungles wearing tennis shoes, or "sneakers" with soft soles. With these shoes on, they sneaked through the underbrush and over the ground without snapping twigs, or brittle, dried sticks.

Camouflage goes on and on, reaching into every section of the world. It is used to hide factories, shops and homes, ships, soldiers and ammunition dumps. Before we were at war with Germany an American in Berlin learned that outside the city was one of the German's cleverest camouflage projects. Beyond the city limits the Germans had built an entire city. The buildings themselves had no windowpanes, doors, or roofs. But inside, the Germans had piled refuse and inflammables ready to set off at a moment's warning. There were dummy streets laid out with lights, and mile after mile of decoys which would give the impression from the air that the pilot was directly over a blacked-out city. At the approach of Allied bombers, the Germans were all set to light up their decoy city with smoke and roaring flames. Over Germany this process had been duplicated for many of the larger cities. With reports of these ruses in the hands of Allied fighters, they have during the past eighteen months hunted out their targets with wary eyes. Few bombs have been wasted in the wrong place, according to British reports.

Camouflage engineers in our Army have not been idle. That cozy little cottage you see on a road outside of San Francisco, or that service station on the road from Miami to Palm Beach might tell a military secret if you knew what lay under its roof. Who knows? It might be aviation gasoline. Then again—?

Chapter Twelve

MAP MAKERS

NO STORY IS PACKED with more human drama than that of the map. Kings have staked their thrones on weird sketches of unknown lands and oceans. Pirates, gold hunters and adventurers have gambled their lives on fragments of information gleaned from crudely penciled maps on hides, wooden slabs, stones and faded yellow paper. Our armed forces are, at this very hour, locked in a death grip with the enemy to correct lines of the world's map ruptured by avarice, greed and the Axis yen to make one single map trimmed with rising suns, swastikas, and Roman symbols.

In this war the Army engineers are making maps by the million. The war cannot be won by maps alone, but neither can it be won without them. If the importance of each engineer function in the Army could be measured accurately, the making of maps would surely rank high.

Not a single soldier can be moved from one point to another, unless somewhere on a commanding officer's desk is a map that covers the terrain the soldier travels over. The layman cannot begin to imagine the number of maps required to move ten million or more men, divided into more than a hundred divisions, across rivers and oceans, through jungles and deserts, from island to island, and from one hemisphere to another.

The Army Map Service at Washington, D.C., run by the Army engineers, turns out 4,000,000 maps per month. This means more than 100,000 maps each day from one single plant. Add this figure

to those produced by the scattered topographic battalions making maps from Suez to Chunking, and the sum is staggering.

In maneuvers in 1941, when our growing Army was still a small one, the troops entrained for the South to practice war games in an area of a little more than 46,000 square miles. Compared to the area over which the Army is dispersed today, that 46,000 square miles is about like a Victory Garden on a Park Avenue roof top. But to map that same area, as required under war conditions, aided also by friendly people and many already completed surveys, the Army surveyed and manufactured *200 tons of maps!* Let your imagination try to take that in.

If the civilian is concerned about the size of his daily paper or his favorite magazine, or about changes suggested by the government in the use of ink and paper, he can find reassurance in knowing the Army engineers are contributing factors to the present condition. They are fighting a war and they have to have maps. When the figures are finally in, perhaps some industrious writer will dig into the Army's map-making business and turn out an amazing story about the thousands of tons of ink and paper and the printing facilities required to do this mammoth job.

To the map-making job of the Army engineers, one can also add those of the Navy and the many government agencies which require maps by the thousands to keep the wheels of a democracy turning at a war clip.

Military maps must tell a complete story for the soldier. They must show clearly not only the roads, rivers and cities ordinarily shown on civilian maps, but also a system of contour lines by which the elevation of any point of land on the map may be determined. This can be understood by using the artilleryman as an example. He can take a military map, and with his heavy gun hit a far-distant target which he may not ever have seen, and which he cannot see at the time he fires the gun. He plots his range from elevation lines of the map.

Other information on military maps which would be of little value to the civilian are figures showing the width of roads, and the load capacities and vehicle clearances of bridges. Also, they must show data the soldier will need in repairing or demolishing bridges. Supply trains driving toward a tunnel, carrying a load of military stores or troops, cannot proceed through a tunnel unless the Army engineer has a map giving exact dimensions, including length and clearance, gauge of rails and so forth.

Normally a military map is drawn with such accuracy a trained soldier can pick it up and almost tell you whether the terrain ahead is occupied by natives who wear turbans, or savages who ride in canoes.

Distance on a military map is determined by use of a scale printed thereon. Small-scale maps, used mostly by commanders of sizable troops units, are printed on a scale of about two miles to the inch. As the size of the military unit decreases the ratio changes. For instance, three inches on the map equals approximately one mile on the ground when used by commanders of such units as companies and platoons. The closer the men are to the center of the combat area, the larger the scale, for they are the men who must sometimes pick out and put out of action a machine-gun nest, or a pill box, located behind a hill perhaps five hundred feet high.

This, however, is only a bird's-eye view of the great detail and painstaking work required of the engineer topographical company working in the field. In the zone of action, maps of all sizes, shapes and degrees of accuracy must be speedily drawn and reproduced in a matter of hours.

The first task of the engineer map maker is to compile material, which means the assembling and checking of all existing maps and photographs available to his unit. His next problem is to convert the information into maps of the size and scale necessary for the particular operation in which his unit is engaged. Then comes the job

of reproducing them in quantities so that each troop commander finds one on his desk, or in his trench when the zero hour strikes.

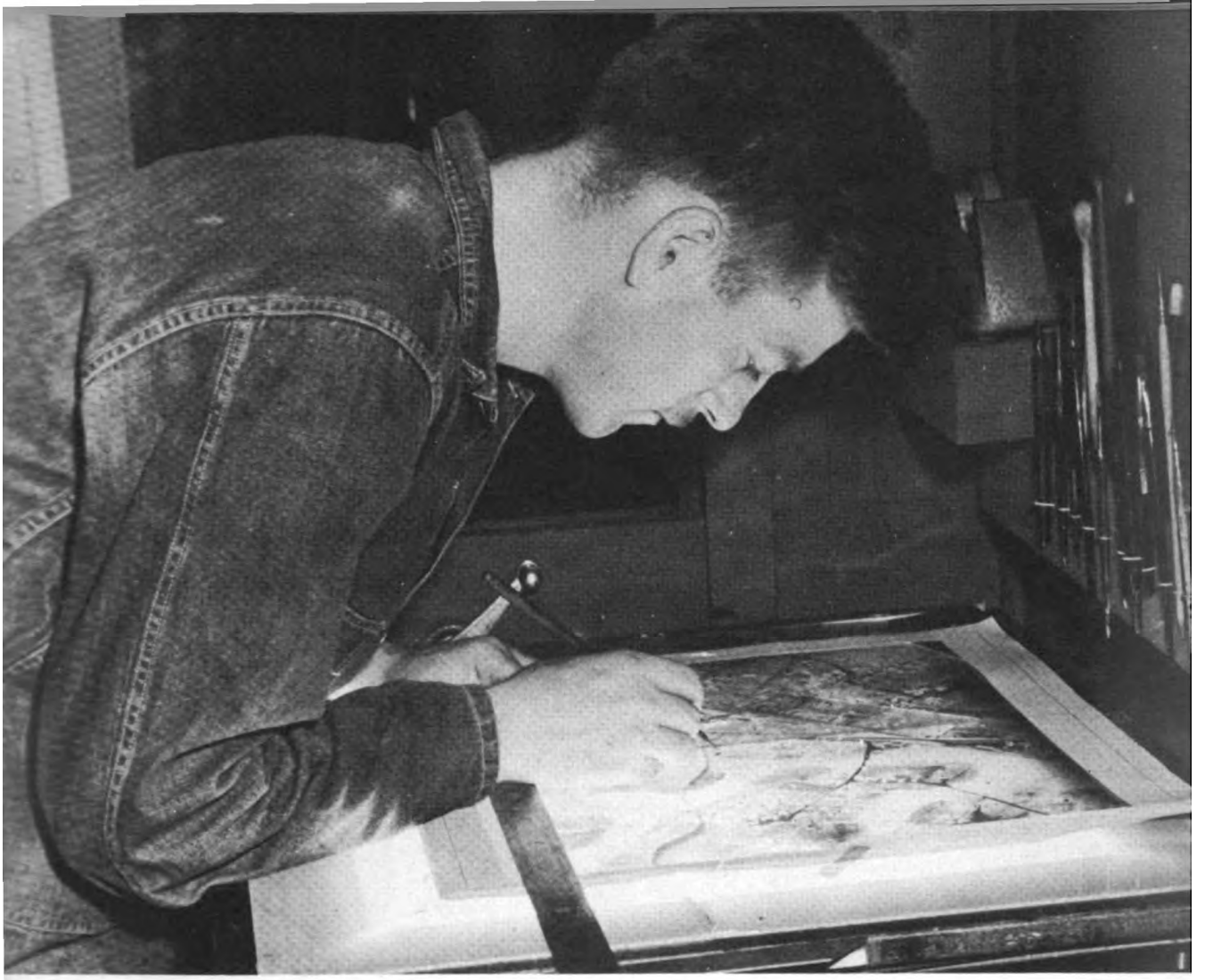
Compilation of information in the field is not altogether easy. Often the information available is a map, or maps, years out of date. Landmarks have been changed, removed, or have been renamed. Roads have been relocated, rail lines discontinued. There are a hundred and one obstacles in the path of the map maker, aside from the comparatively simple job of reproduction once he has all the information in hand.

For the Army in the field, maps must be turned out at blitz speed. There is not time to cable back to the Army Map Service in Washington and request a batch of maps on a thousand-mile stretch of desert just back of Tripoli. The men out there already have hundreds of large-scale maps of the country. The kind they need as the battle clouds roll across the sand are those detailed maps of battery positions, locations of temporary airdromes and concealed troop concentrations, based on intelligence reports on the battle situation by the hour, wherever it may be.

The engineers must make the maps on the spot. To facilitate speedy map-making the Army decentralizes the function. The Army Corps has the topographic company. The Field Army, which may be several corps operating as a unit, has a topographic battalion. The third and largest is the GHQ topographic battalion.

Wheels of the GHQ topographic battalion start spinning at the outbreak of hostilities. Its task is primarily one of reproduction of existing maps of the theater of operations, and of such other maps, sketches and drawings of a permanent character as may be required later. The organization has all the earmarks of a permanently stationed unit, since all of its equipment is necessarily heavy.

The GHQ battalion is a versatile machine. It must be equipped to dash off the most complicated of maps, using all the latest types of printing processes and equipment. It must also stand ready to reinforce smaller battalions as circumstances demand. And it must



One of the most important engineer jobs in the Army is that of map-making. Topographic engineers must become expert in the craft to make maps under all conditions. Here Sergeant Thomas J. Reen of Cambridge, Mass., is retouching enlarged copy negative before making lithographic plate.

be prepared to make ground surveys complete in all detail for construction of camps, and other large facilities.

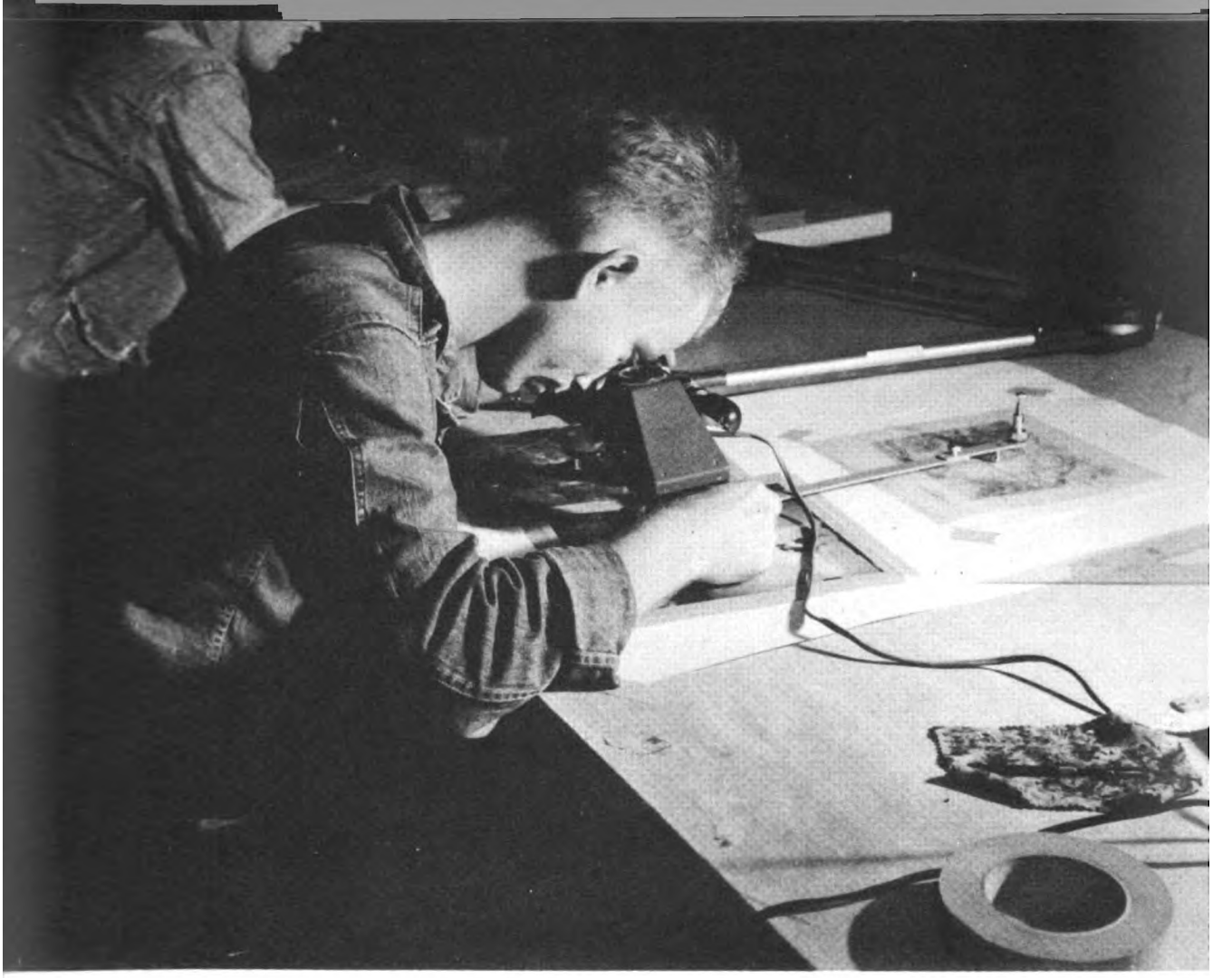
The Corps topographic company includes a headquarters, and three platoons. One platoon is organized for surveying, another for photomapping, and the third for reproduction. The survey platoon is, as its name indicates, equipped with instruments used by engineers in survey operations.

The photomapping platoon, with its stereoscopic equipment, turns aerial photographs into maps. The reproduction unit is simply a printing plant in miniature scale which can reel off hundreds of maps per hour. This outline of the Corps topographic company can be applied to almost any other self-contained topographic unit in the Army. The size of the topographic unit is determined by the size of the military force to which it is assigned.

There are, of course, differences in mobility. A feature of the Corps topographic company is its large semi-trailers, or rolling laboratories. These rolling labs can hop along across country with the Army and make maps as it goes, if necessary.

There is danger aplenty in map-making if it's performed at the front where the forked tongue of battle licks at the soldier map maker. For instance, he is moving up with a field force through a rugged terrain. His mobile equipment, normally a photomapping company trailer-laboratory, may be moving just to the rear of a vanguard of tanks and other armored columns. The area through which the small army is fighting its way is too rugged to accommodate supporting aircraft in a safe landing. But still the photomapping company must get the aerial photographs made by the reconnaissance pilots flying overhead.

The trailer-lab is equipped with radio receiving and sending apparatus. Through its headquarters it contacts the plane on a mission above. The plane's pilot receives the message. He has obtained the pictures of the immediate area ahead through which the armored column is moving. The reconnaissance pilot's cameraman rolls the



Tech. Sergeant Edward V. Sewell of Baltimore, Maryland, working on aerial photos with stereocomparograph to show relief of terrain in topographical map.

films, slips them into a container attached to a miniature parachute. The plane swoops down over the trailer-lab and its crew, for the pilot has been radioed the exact location of the trailer beforehand. He drops the tiny parachute with its precious films and they fall into the photomapping crew's hands. The engineer map makers dash to the trailer, develop the films, and can run off a map of the area in a few minutes. Meanwhile, shells may be dropping on all sides of the photomapping company trailer-lab. But the maps are run off quickly and the troop commanders up ahead get their maps perhaps an hour later from the hands of a motorcycle dispatch rider who has raced up through the shell-torn area with them.

At the beginning of an operation a completely detailed map of the terrain may not be available and only incomplete and fragmentary information exists as the basis for a map. In this instance, the topographic battalion goes into action. It forgets the fine flourishes of neat penmanship and polished printing, and comes up with a rough guide map. As the battle progresses the battalion, working through the various companies in the field units, moves as far ahead as possible toward the front, recording every bit of information relayed back from reconnaissance units, military intelligence and aerial photographers. The maps are then drawn literally as the army moves ahead.

Few examples of teamwork excel that demonstrated by the engineers and the air forces as they work side by side in the map-making business of war. Development of aerial cameras and photographic equipment added a third dimension to the field of the engineer, who had only begun to feel his way with aerial photography at the close of World War I. As the air forces learned more about aerial reconnaissance by camera, the engineers carried on experiments on the ground which made it possible to translate aerial photographs into maps, accurately and quickly.

No soldier will deny that a map is a weapon, and a valuable one. And the engineers are rushing headlong into the unknown to un-

Sgt. George Campell of Medford, Massachusetts, operating an offset press as one step in turning out military maps in the field. Thousands of engineers are trained for tasks like this which require above the average skill and reasonable academic background.

cover all possible ways of making maps and getting them to soldiers hacking their way through tangled regions of the world.

Most amazing of these developments at the hands of the engineers is a map which, as one writer described it, "lights up like a Christmas tree." With this startling new map, a pilot flying in a blacked-out plane above enemy territory can chart his course safe from enemy eyes. Developed shortly before the African campaign, these new maps are the answer to a pilot's prayer. The intricate process the engineers use in making these precious war instruments is, of course, secret. But the Army does explain that they are printed with fluorescent inks which glow in a pitch-dark chamber under a tiny ultra-violet ray light beam.

When a pilot lifts his roaring bomber up into the midnight sky and is sailing along over his target thousands of feet up he is in no mood to risk turning on his cabin lights to check his maps. It is then that the magic maps come to life. Around the pilot's helmet is a small band which holds his ultra-violet ray lamp in place. He bends his head forward over the map and switches on the head lamp. In a matter of seconds the tiny fluorescent lines creep into an illuminated outline of the terrain below. The lines are plainly visible to the man at the controls in the dark cabin, but beyond the reach of a searching enemy eye on the ground or in the air. Further back in the blacked-out bomber the navigator can use the same instruments to carve out of the black night the bearings for their homeward trip after the bombs are away.

More engineer magic is up the Army's sleeve that will furnish neither aid nor comfort to the Axis. This is in the fourth dimension, and is being groomed for fighting perfection. It is radio facsimile, which will transmit a map, picture, or printed material at a speed almost as great as light.

Engineers naturally cannot broadcast all they know while the nation's armed forces are battering at the enemy gates, but reports

on this amazing radio device, published as far back as 1940, are comforting.

Even then tests were being made successfully, on a machine weighing less than twenty-five pounds, which served both as a receiver and transmitter, and turned out pictures almost eight inches square. In radio transmission there is a process frequently used by the enemy known as "jamming." But this radio facsimile, in 1940, could not be disturbed by man-made interference, or by natural electrical storms.

As a reconnaissance instrument, this type of map transmission is an engineer officer's dream. Planes taking aerial photographs over enemy territory can be shot down before returning with their precious cargo of films; but equipped with radio facsimile, the plane can fly out over the enemy lines, take photographs and send them back by wireless to the topographic photomapping company. Then if the plane is knocked out of the air, the maps will probably be running off the press before the plane falls to the earth.

It is known that German Panzer divisions have used facsimile-equipped scout cars, tanks and planes in reconnaissance operations with some success. But our Army engineers have a way of making something as good, then creating something better, and finally, improving upon the "impossible"—even in maps.

Typical engineer trail blazers along the Alcan. They are surveying and marking the route through wilderness. Behind come bulldozers, more engineers and machines, blasting the road to Tokyo.

Chapter Thirteen

TRAIL BLAZERS

SOMEDAY A JACK LONDON or a Rex Beach will slip away quietly, drop in at Dawson Creek in British Columbia, then press on leisurely up the Alcan Highway toward the Yukon. He will collect legends and saturate himself with the stupendous wonders civilization and war have wrought on the wildest carpet of virgin territory left in North America. Then he will sit down and pen a gripping saga, the Alaskan-Canadian Highway drama.

The incredible speed with which the Army engineers, with civilian aid, rushed this giant supply strip across the wilderness into the gold and salmon country is a tonic to the imagination.

In October, 1942, the War Department handed reporters a press release of about 200 words stating that Sunday afternoon, November 20, the 1671-mile length of the Alcan Highway would be formally opened. The place was to be at the Alaskan-Canadian border. Trucks would begin to run over the entire length of the road that week, carrying munitions and material to troops in Alaska, said the story.

That mild-sounding news account was a bearer of good tidings, for it meant the forging of a link between the United States and one of its most valuable possessions. It was in effect a signal to the nation that new frontiers would soon open, new firesides would glow in the North. There was a sparkle of new hope born again in the fires of war.

However, that story was a prelude to another portentous event—the swing across the Atlantic and the plunge into Africa by our armed forces. A few days later our troops landed in North Africa, and the Alcan Highway was lost again to the news world. A mantle of secrecy fell on the North. And so did the Arctic blizzards, sleet, rain, snow—the coldest winter in forty years; and more bombs fell on the Aleutians.

Around the beginning of 1943 stories began to seep out at intervals through various channels and America learned a little more of the magnificent tale of the Alcan road. How many hundreds of American soldiers marched, rode and flew along the Alcan road during the winter of 1942-43 no one but the Army knows. There were probably many. At any rate, the Japs did not sweep in over the snow-clad Alaskan mountains and down onto the Pacific coast of California.

Seven Army engineer regiments plus more than 2,000 civilian workmen cut the Alcan Highway through the Northern wilds in less than seven months. They rolled along at the rate of eight miles per day, bridged 200 streams and laid a roadway averaging 24 feet in width. At the highest point the road climbed up to an altitude of 4212 feet, between Fort Nelson and Watson Lake.

To get supplies, mail and reports up and back down the trail the engineers used every modern means of communication and some methods common to the gold rush days of the eighties. Harnessed to the job at one time or another during the actual construction period were pack horses led by Indian guides, accompanied by survey parties. In some instances messages, medical supplies and food were carried by dog sled, mushed over the frozen snows by natives of the Canadian Northwest, and frequently by soldiers hooded to the tip of the nose in regulation Army parkas.

Many supplies and much heavy equipment were flown in over the unknown mountains and forests and winding rivers, some of the territory never touched by white men's feet. Light pontoon-equipped planes with vaccine, clothing and instruments made their ways into

Back home in the states these engineers learned about bridges and pontons. After the Alcan they were veterans. Here they operated a ferry. In foreground engineers unload part of a trestle bridge soon to replace the ferry.

almost inaccessible spots, landing on lakes and silvery rivers. The life-savers were the giant C-47 transports, piloted by Army Air Force flyers. They hauled everything from jeeps, parts of trucks, trailers and tractors, to alarm clocks and stationery. In some instances heavy construction equipment was loaded on barges and flat-bottomed boats and floated to their destinations.

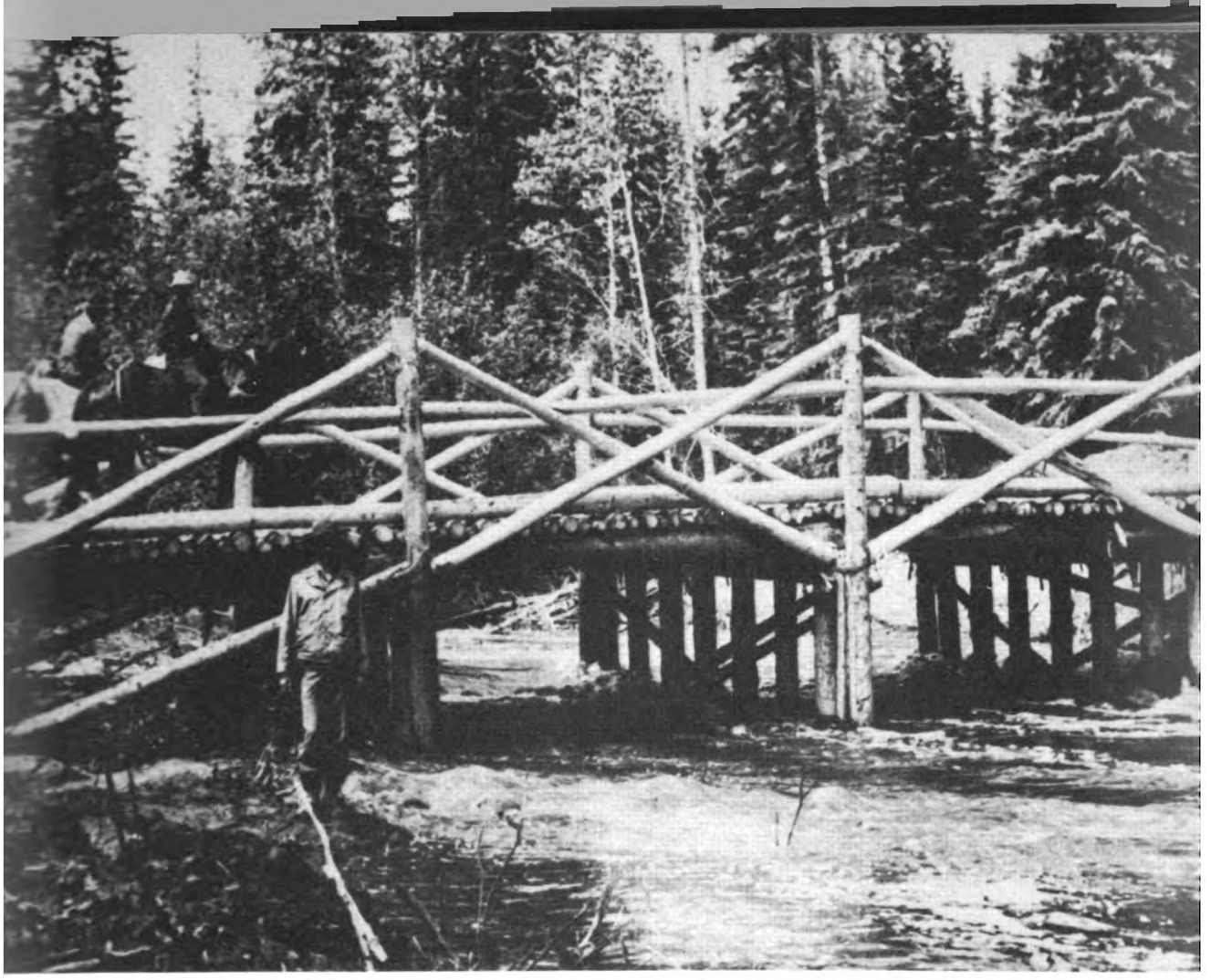
The Army engineers exhibited daring and skill as they marched and slogged their way through the forests and over the treacherous muskeg swamps and bogs. The sticky tentacles of the muskeg could pull a ten-ton caterpillar tractor or truck down out of sight in a matter of minutes.

The engineers dynamited and hacked the way clear for the big motor transport trucks. Knife-bladed bulldozers tugged, grunted and plunged into the wilderness to clear a route for which blueprints were not even drawn, for detailed blueprints were not even well thought out, much less drawn, when the engineers plunged into the region to build the road.

This was strictly a war feature, for the engineers seldom tackle a job that isn't under the range of gunfire without a complete set of scaled prints for each foot of construction. In the case of the Alcan Highway the engineers simply hacked and shoved the trees out of the way with an army of bulldozers, scrapers on one hand, and with the other hand they drew the plans on the strength of what lay beyond the next half-mile of the unknown.

Before looking closer at the details of the engineer attack on the North, let's look at the route the road follows. For as the years roll on many an American will find himself headed up the Alcan Highway for a vacation and first-hand view of one of the greatest wonderlands of the world.

The southern tip of the road is at Dawson Creek in British Columbia. It connects there with the Northern Alberta Railroad. At Dawson Creek it also ties in with both airline and highway to Edmonton, which is nearly 600 miles southeast. From Dawson Creek



Nothing stopped the engineers on the Alcan. Often without bridge steel they improvised. In crossing this stream the engineers built a timber bridge as artistic as it is rugged and serviceable.

the road follows an old provincial trail for about 50 miles in a northwesterly direction to Fort St. John, then almost due north for nearly 300 miles to Fort Nelson over the route of a pack trail. At Fort Nelson the road swings again in a northwesterly direction for 360 miles, up over the Continental Divide to Watson Lake. At Watson Lake it goes northwest again for 275 miles through Teslin Lake into Yukon Territory, to connect with the White Pass and Yukon Railway at Whitehorse. From Whitehorse the Alcan then proceeds on northwest through the gold country past Kluane Lake, thence across the Alaskan border at Tanana Crossing to Big Delta. The last 100-mile lap covers a road previously built southward from Fairbanks to Valdez, on the southern Alaskan coast east of Anchorage.

Not many people outside of a few scattered trapper and prospector settlements have any conception of the untamed wilderness through which the engineers made their way to build the Alcan. Even trappers are unfamiliar with hundreds of square miles of the dense timberland, crisscrossed by rumbling rivers and streams. Captain F. C. Bishop, a Northwest Service Command officer, described the area in this way: "It was a vast wilderness of swamps, forests, rivers and mountain ranges. Much of it eyes of white men hadn't seen. Maps were incomplete. Not even Royal Canadian Mounted Police patrols had unlocked all the secrets of this great solitude."

Strewn across this 1671-mile stretch of virgin terrain are enough natural barriers to challenge all the clever and ingenious machinery ever devised within the boundaries of the United States. And that puts it mildly, say the engineers who struggled with this project. The muskeg swamps cannot be traversed with any degree of surefootedness except when frozen. Swiftly flowing ice-laden streams saw bridge timbers into splinters in a few hours. There are rolling hills thick with vegetation and tall timber; sheer rock-walled canyons; and vast stretches covered with stubborn glacial debris.

Engineers didn't wait for materials while building the Alcan. Equipped with excellent training and plenty of ingenuity they improvised ponton ferries and here they construct a ferry slip to accommodate one of their home-made craft.

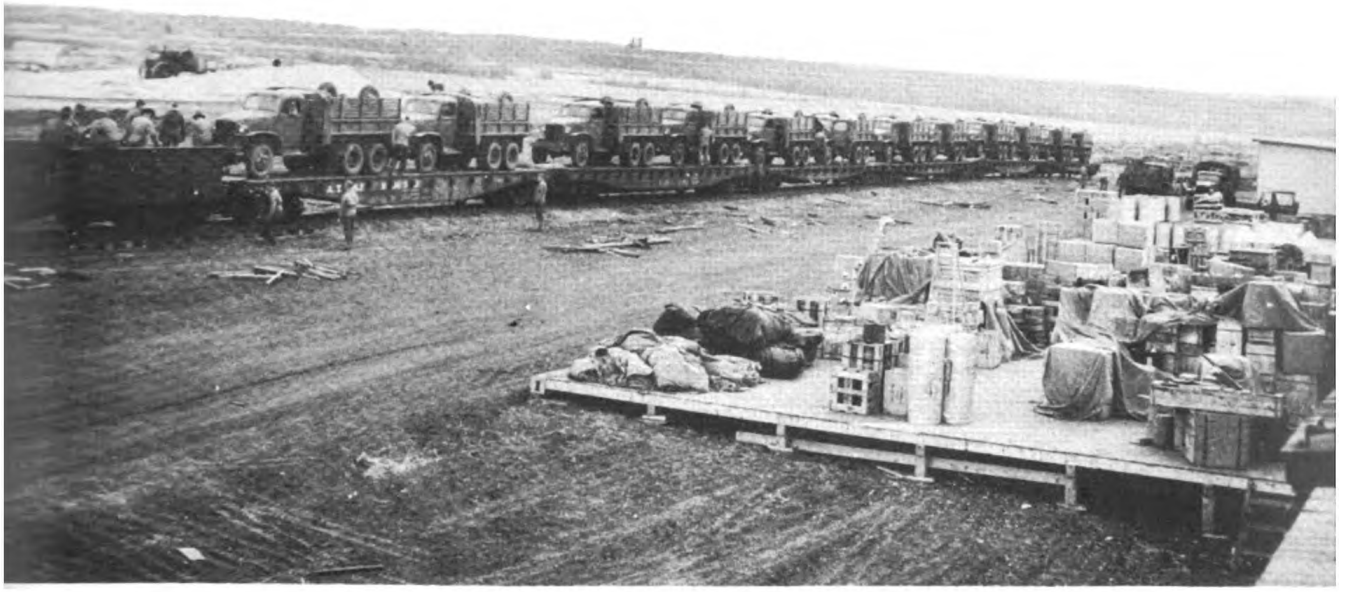
It was through this panorama of natural wonder and tangled waste of wild growth and confusion that the engineers carried on a bare-handed tussle during the long lonesome months. Little entertainment came to the North along the trail except the radio broadcasts from the States, and these came with a sputtering sound.

On this bleak stage the small band of engineer officers and an engineer employed by the Public Roads Administration landed on the morning of March 9, 1942, at Dawson Creek. The cold was intense and the job ahead of them looked almost overwhelming. That stretch of land that tumbled off into the unknown from the railhead town of Dawson Creek had all the earmarks of the dismal end of civilization to the engineers. But usually when an engineer sets out on a job his jaws are pretty well set in a determined vise.

At approximately the same time, advance survey parties were pitching camp at Whitehorse, about midway from Dawson Creek. Up in Alaska a third crew was setting up a camp. The overall plan for the road called for dividing it into two sectors, northern and southern. The southern strip was to cover about 700 miles, while the northern sector included the other 900. The two were scheduled to be joined in the southern Yukon at Watson Lake.

In a few days troops were moving into Dawson Creek behind the original survey crew, setting up a supply base; then came the task of getting supplies and men over the almost impassable provincial trail to Fort St. John and other points, including Fort Nelson, before April thaws turned the whole area into a quagmire of muskeg and roaring streams.

Truck drivers who could drive a slugging eight-wheel job up a straight side of a cliff if they had to, worked day and night. They fought their way with the aid of tractors, bulldozers and winches over every mile to Fort Nelson. At the beginning, the temperature often dropped to 40 below zero. Later on, toward summer, they had to drag the big trucks through endless stretches of sticky mud.



Scenes such as this dotted the Alcan route as construction began. Here a rail line was a luxury. Once off the flat cars, trucks found the going rough. Engineers loaded trucks with supplies, equipment, and men, and plowed on through uncharted wilds beyond. These trucks proved to be Twentieth Century motorized Covered Wagons. Engineer pioneers pushed them through to finish the road.

The engineers knew that by April 10 there would no longer be a bottom to that territory, and they gave the job everything they had. This stubborn battle continued until April 9, when overland ferrying was halted.

Meanwhile, the big C-47's of the Army Air Force were roaring back and forth hauling medical supplies, dismantled machines which when assembled weighed tons, an occasional casualty struck by flying timber or injured by the awkward jerk of a machine, a dog team and sled, or a group of officers on an inspection tour.

"Before the thaws stopped the overland ferrying on April 9," Captain Bishop said, "Cats [caterpillar tractors] had dragged loads of food, dynamite, axes, shovels and tents to points all along the British Columbia-Alberta boundary from Fort St. John. On the ice-coated rivers this equipment was sledded," he added. "Sometimes the ice creaked ominously; it even cracked at times. But it held. By the time the thaw made the region impassable, there were islands of American equipment all through the wilderness. From these base camps the men started the job," Captain Bishop said.

As April appeared on the calendar and the big trucks and "Cats" stopped moving, the actual building got underway. It had been the Army's plan to construct a "tote" road about twelve to fifteen feet wide to accommodate the Army temporarily and to serve as a broken trail for the Public Roads Administration and contractors to follow in building the completed road.

However, a short stab into the wilderness with this process quickly showed the engineers the folly of trying to hew two roads across such a stretch. The contractors pooled their equipment with the Army's and strung it out over the length of the road at strategic points. Mostly, they worked behind the engineers, widening out the road and fortifying the rougher spots. But occasionally the contractors were given short stretches ahead of the engineers to pioneer.

It had been late in March before advance survey parties arrived in force at Whitehorse to organize a base and begin the necessary

Men, tools and supplies were rushed into areas like this seldom seen by white men in the North. Trucks and machines on the barge were soon ashore hacking and scraping a trail across the rugged terrain to complete another link of the Alcan.

reconnaissance and start surveying the territory through which the road would pass. However, the northern sector was accommodated by more favorable travel and communication lines, since trapper and prospector trails and fairly accessible water routes pretty well threaded the territory of that area.

All during April men and supplies poured into Whitehorse by way of the White Pass and Yukon Railway. Some came by air. But it was June before troops could get equipment set and start mushing into the trackless wastes.

All summer long as the troops tore, slugged and clawed at the untamed stretch of country for 1600 miles each officer had but one idea in mind—"Get a supply line to Alaska," enhanced by a very brief order from the Chief of Engineers which read, "The pioneer road will be pushed to completion with all speed within the physical capacity of the troops." Other than that order the engineers were blazing a trail and making up specifications to fit the job as it unrolled.

The troops within whose "physical capacity" the road was being built were not lumberjacks, woodsmen or picked construction men with bulging muscles and hard tongues. Far from it. They were the boys who had volunteered. They were young men inducted through the channels of Selective Service. There were both white and colored boys. They were the kind of young men found behind a counter at Childs in New York; driving a truck from Phoenix to Los Angeles; working as a bus boy in a North Side restaurant in Chicago; or working as a carpenter at Tuscaloosa, Alabama.

They were Army engineers, trained at Fort Belvoir, Virginia, and at Fort Leonard Wood, Missouri, and later in maneuvers in the south in Tennessee and in the Far West. It was indeed an awakening for these twentieth-century pioneers!

The engineers ran into problems not encountered since their predecessors combed the wilds of the United States to survey the

Tools and equipment which broke under the strain were repaired on the spot. Engineer welders and mechanics trained at Fort Leonard Wood, Missouri, and Fort Belvoir, Virginia, kept the machines moving. Repairs were made day and night, in jungle swamps, and in 40 below zero cold.

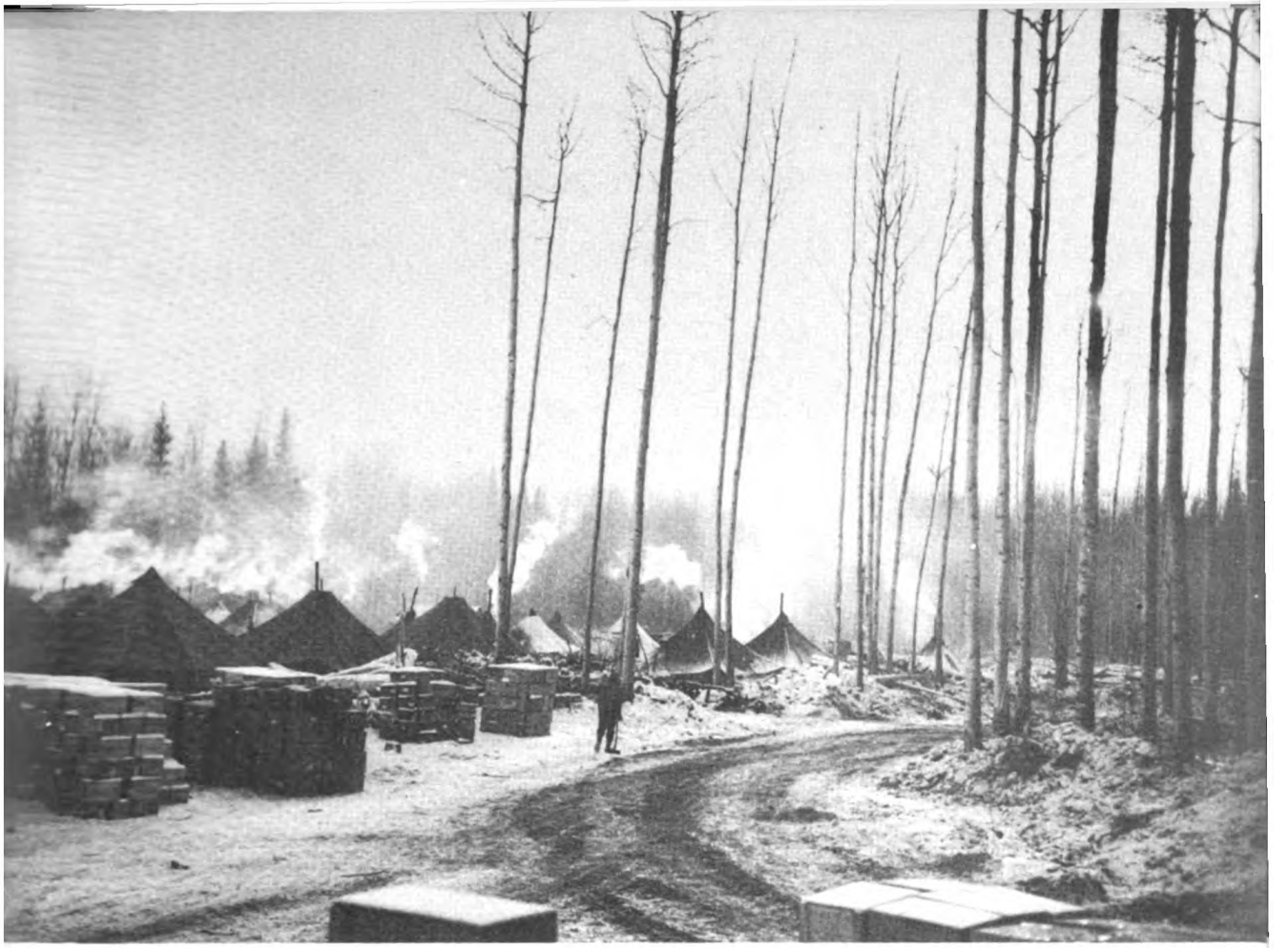
first coast-to-coast rail routes. It was a pioneer job from every angle.

The young engineers grinned and bent their backs when they saw supplies coming into their remote camps on pack horses, on men's backs and on sledges tugged along by huge caterpillar tractors. They realized they were far from civilization when planes swooped into one of the far-distant camps for a landing on a crystal-clear lake from which they hooked many a trout during a precious hour away from the job. But they took wholeheartedly to resourcefulness and ingenuity.

"Ever since the ice sheets of the Pleistocene Age blanketed the continent, the land of the Far North has been impregnated with ice," Captain Bishop of the Northwest Service Command related. "It never had a chance to dry out. Dig down a few feet and layers of ice appear. In the spring thaws these layers turn to a soup. In the autumn they freeze again. This made it imperative to put a thick surface on the road. Yet along many sections of the road gravel was not available; and when the thermometer dropped below zero gravel beds became as hard as anvils; dynamite wouldn't budge them," Bishop explained.

All along the route the engineers cut timber from beside the road and laid it in strips as the first blanket of surface cover. The engineers pushing the big bulldozers uprooted spruce trees, bushes, ferns and anything else in the path. The timber and debris were then spread in many instances along the foundation of the road to form a springy mat and buttress between the roadbed and the sheet of ice below the surface. At many critical points along the route spruce poles were cut and laid side by side to provide the roadbed. This was especially true of the Yukon stretch.

Wherever possible, the engineer highway builders made use of the forests which lined the route. Portable sawmills cut lumber for barracks, maintenance camps and tool sheds. Steel piles for culverts could not be had in the wilds, so the engineers made culverts and bridges from piles and planks sawed within a few strides of the road.



In camps like this, scattered the 1,671-mile length of the Alcan, engineers lived the pioneer life indeed! With no time to throw up shelter for little other than bodily comfort, stores were stacked on the ground. Timber cut near by furnished fuel for the Sibley stove in each tent.

Harnessing their ingenuity, the engineers cut timbers and lumber with the portable sawmill equipment and bridged glacial rivers in the short space of two or three days. This rugged drama went on day after day, week in and week out. Since the supply of heavy metal tow chains and such materials was always limited, the engineers often cut a heavy pole and used it as a tow link to drag pile drivers by caterpillar tractor from one location to another. "We do everything with wood but eat it," an officer at one location said.

Experiences of the young engineers who battled the Far North will be recounted for many a day. Often in very remote sections food was not always easy to get in over the unstable supply lines. So they occasionally took to the woods and bagged their own from the reaches of their camp. They often drifted into the woods and came struggling back with moose meat, deer meat or trout, snagged with a well-placed bullet or a fly rod.

Rivers spawned in the icy tumbles of a glacier do not make good streams for bathing, so empty oil drums were drilled full of holes in one end and suspended in trees or improvised shelters to serve as showers. To get the precious bath the engineers organized into small teams. One group boiled the water and kept the fire stoked, while the other scraped off the grime. Then the teams exchanged positions.

For many years natives of the North Country will retell the deeds of the engineers' fight with the wilderness. Never did the engineers do so much improvising as was done on that 1600-mile stretch. During much of the construction streams were often too high to permit the building of bridges. But that did not stop the engineers. They pulled out their tools, improvised rafts and pontoons, and built ferries right on the spot, then harnessed the swift stream to tow the ferry in both directions, crossing and recrossing the water.

They used motors only when absolutely necessary. At one crossing, troops built from spruce lumber a scow capable of transporting forty tons of equipment! At one point a Negro regiment from sunny

This giant bulldozer piloted by an engineer private bites into the "muskeg," carving out the pioneer trail. Other engineers followed. Logs and gravel provided the surface coat.

Alabama threw a bridge across a river in forty-two hours that easily accommodated multiple-ton transport trucks.

At very few spots along the route did any signs of civilization appear. Where they did, troops made the most of them. On the mountainous shores of Kluane Lake in the Yukon two tumble-down trappers' cabins were turned into headquarters for an engineer regiment. On the stretch between Fairbanks and the international boundary troops ran short of timbers. A high trestle on an abandoned mining railroad was torn down and the timbers and piling put into bridges for the road. This railroad, incidentally, was the line which inspired Rex Beach's novel, *The Iron Trail.*

At another point the engineers superimposed the road on the face of a cliff that dropped straight down a thousand feet into the deep, still waters of a volcanic lake.

To get at this and similar stretches of the route the engineers often tied ropes around their waists, swung over the side of the cliff, belts loaded with dynamite and cold frostbitten hands clutching pneumatic drills. They drilled into the rock wall, inserted dynamite, hoisted themselves to the top of the cliff, and set off the blast. They literally knocked the roadbed out of the canyon wall. Lieutenant Donald D. Zaiser, who drove one of these miracle strips through a canyon's face, heaped the highest praise on his crew. Of such stuff are heroes made.

Captain Arthur R. Campman and his crew tore into another 1100-foot strip of peril and hoisted a bridge across a raging stream, using only light field construction equipment. The piling was dragged from the near-by forest and driven into place while the swirling flood waters churned and ripped at the men. The piling was driven in even before the sap could stop running from the timber. A portable sawmill set up on the side ripped slabs from trees an hour after they were cut and sliced the timber out for the superstructure.

At another location the engineers were slowed down considerably when they were forced to corduroy a strip of the road for thirty-five

miles. This meant cutting timber, laying it horizontally across the roadbed, one tree trunk beside another. What stubborn patience! After laying tree trunks over the strip, gravel had to be hauled many miles after being dug out of frozen pits.

On another occasion a feat of daring probably unsurpassed along the road was the ferrying of 800 soldiers over four and a half miles on regular Army pontoon equipment. The full complement was moved with no serious accident in the face of lashing waves and a freezing cold wind sweeping across the thirty miles of Kluane Lake. Captain Maurice Campton, of Seattle, said he was quite happy when the last man landed.

In the Alcan battle there were heroes, too, who didn't come back. Lieutenant Roland Small, of New York City, gave his life to the road. He was killed in a motor accident, while directing a pile-driving operation at night. Private David S. Madrid was awarded the Soldier's Medal for heroism for attempting to save the life of a companion who was drowned when he was swept down with the icy current of a stream on which they were working. On Charlie Lake, a squall capsized a ferry, drowning ten soldiers and two officers. In another mishap, a tug which was towing a barge loaded with equipment along the Alaskan Inside Passage sank with all hands aboard.

The camps were spread out along the 1671-mile route a few miles apart. Men working on their own little forty- to sixty-mile strip knew little about the country that lay beyond. But there was a rousing competitive spirit. Each group of men was proud of its section of road, and believed it was the finest of the whole 1600 miles. In the Far North the sun did not drop below the horizon for more than a couple of hours at a time, and the men worked normally in ten-hour shifts. Often it was necessary to work two shifts in one, a twenty-hour stretch, if the particular job happened to be an emergency. And there were many such.

Frequently the engineers slipped out of their warm sleeping bags in the arctic night to stoke up the fire in a stove made of an oil drum and fired with chunks of wood. When the temperature dropped to 40 below, keeping a fire going, if you could get one started, was no mean trick. Over the whole trail most of the men lived in tents, for there hadn't been time to build barracks for all.

Many a blizzard-soaked night when the temperature was far below zero, a little group of engineers, hustled out of their sleeping bags, heated up a caterpillar tractor and slogged off along the naked strip through the woods to pull a big truck out of the muskeg and get it back on hard ground.

While rushing to get bridges across the ice-choked streams or to repair a bridge almost torn loose by the swirling water, the engineers stripped off clothing, waded into the icy stream up to the armpits and held timber in place while it was driven into the stream bed.

After the icy blasts of March and the quagmire swamps and muddy, slushy seas of April, the summer brought swarms of mosquitoes and flies and other insects by the million. Some of the tales of the big mosquitoes are classics. "Every mosquito up there was on a suicide mission," said one engineer. "They took off from a swamp, zoomed up to ten thousand feet, and then power-dived right into your exposed deck, sinking a torpedo stinger that raised welts like hen eggs."

Of all the stories the one most likely to become legend is that of Sergeant Frank Carpenter, of Knoxville, Tennessee. The story goes that Carpenter was swimming in the Miniker River when a large grizzly bear marched out of the timber and without benefit of pontoon equipment started propelling his big shaggy carcass out toward Carpenter. Carpenter countered with an iron fist and contacted the grizzly on the beezer. He was caught in a barrage of body claws and scratches by the bear, and he couldn't very well circle around the animal and get ashore. He decided to fight it out with

the bear if it took all summer, and he did. Carpenter was well in a few days after the encounter and back at work on the road.

A reminder of his prowess is found in this poem, printed in an army camp newspaper several thousand miles from where the episode occurred:

THE BARE IDEA

It's up on the Alaskan road, a river cool and clear,
And Sergeant Frank H. Carpenter, a Combat Engineer,
Was standing on its grassy bank, a figure filled with vim,
Said he, "That water looks so good, I think I'll take a swim."

No sooner said than done, his clothes were hung upon a tree,
And Carpenter, in birthday suit, was splashing round with glee;
And wishing for companions who this novel treat might share,
When all at once, from out the woods, loomed up a grizzly bear.

The grizzly seemed to think the sergeant had no business there,
And few folks care to tangle with a full-grown grizzly bear.
The bear attacked; the sergeant, facing this unequal bout,
Just doubled up his fists and smashed the bear upon the snout.

The battle raged, the bear pressed in, his claws set for attack,
And Carpenter was wounded sore, but *not upon his back*,
The sergeant kept on hitting till the grizzly's nose turned red,
Till the bear gave up the struggle, turned his tail and fled.

Now the other forces fighting for our bewhiskered Uncle Sam
Can brag about their toughness, Engineers don't give a damn;
For they know that when the cards are down and witnesses are there,
No one but a Combat Engineer could lick a grizzly bear.

Engineer Section
535 Base Line.

The endless grind of twenty-four hours a day was tough on the men, but in spite of this rough sledding few of them suffered from any kind of illness. Engineer water supply companies worked tirelessly searching out supply points, and chlorinating and purifying the water for their fellow builders. Often the men could get water only by melting ice, and this is not easy when the thermometer hovers below zero. At times water was even pressed out of the muskeg, strained and purified, and though it was the color of amber the men drank it gladly.

Although speed was the essence of the undertaking, the men frequently found a few off hours to enjoy the excellent hunting. Bear, deer and other game filtered through the woods almost at the elbows of the men as they worked. The mountain streams were alive with trout and other game fish.

Since radio reception was bad, and many sections of the road were impassable at times, it was not easy for entertainers to be transported up the trail, and the men found their own. Mostly they relied on a pack of playing cards, which provided a diversion in an occasional hand of poker.

The officers fared no better than the enlisted men. At the end of an unusually rough stretch the officers dropped almost in their tracks and slept on the open ground, or in hurriedly pitched tents beside the mud-soaked engineer soldiers. They stood in line at mess and ate food hurriedly before it froze on the plate. At times they ate what they could shoot in the surrounding timber. Many a bear was roasted over a hot fire and devoured on the spot by hungry soldiers. The men ate from cans, jars, boxes and any other receptacle handy if the mess tent could not be thrown up before mealtime. As the road unwound and rolled on over the mountains, across rivers, through snow, up and down hills, these young Americans learned the hard technique of primitive existence. And most of them came through the ordeal in better physical trim than they had ever been in their lives.

Forty per cent of the engineer troops who built the road were

Negro soldiers from the South. At first there was doubt as to whether they could stand the biting cold, but as time dragged on into months many of them stood the test better than their white colleagues from places like New York, Detroit and Chicago. They did indeed win their place in the ranks of the Corps of Engineers. The colored engineer soldiers endured the hardships with little concern, and their commanding officers are high in their praise of the way they carried on.

As the road was cut through the wilderness airports hewn out of the few flat stretches along the route took shape. A belt of air depots and bases insure the safety of the road, although it was deliberately laid in mountain valleys to provide natural protection in the event of attack.

The Alcan removes the submarine menace in getting supplies and soldiers to Alaska, although Lieutenant General Brehon B. Somervell, Commanding General, Army Service Forces, is considering a railroad straight through to weld the connection permanently by rail. Such a rail route is already being surveyed by the air force. The railroad would lead 1300 miles northward to connect with the Alaskan railroad. When and if this road is completed it will give the United States four routes to Alaska—air, rail, highway and sea.

To build the Alcan road across Canada was a diplomatic achievement. The terms of the agreement were that Canada should grant the use of a right-of-way and the United States should pay the cost of building. We needed a road quickly, and Alaska is now safer because of it. Millions of acres of valuable mining and farming areas will be available to settlement eventually. We will have a quick, secure route by which to tap the almost untouched natural resources of Alaska.

The Army engineers are now working on a vital link with the Alcan, down in the Panama jungles. Much of the Alcan story is being repeated there at this moment. With completion of the Panama link, a highway will someday stretch from Alaska down

Two Alcan engineers whet a hunting knife. If signs are indicative these husky soldiers may have deer meat for supper. It would take a sharp knife to skin the animal and carve meat. The engineers often took to the woods with rifle to bag their "chow" on the hoof.

through Canada, the United States and Mexico, across the Panama Canal, and all the way down through South America to Tierra del Fuego.

Men who are engineering these international arteries are linked with a common bond. And there is the instance of the two commanding officers leading advance crews of soldier engineers, who broke through the underbrush near the Alaskan-Canadian border on October 25, 1942. A whoop of joy rang through the woods when Major O. D. Bridges and Captain Walter H. Parsons, Jr., recognized each other. They had been classmates at Texas A & M College, and now they had cut the last foot of the Alcan and put a period to a historical line.

Chapter Fourteen

BRIDGE BUILDERS AND PONTOONEERS

THE ENGINEER AND HIS bridges are a tradition. Engineers have been building bridges for generations, and bridges are still highly important to war, but the technique in river crossing is gradually changing on the battle front. It is fascinating to think of the many decisive battles decided at river crossings. Rivers were once a natural barrier to armies. Therefore it was natural that armies draw up to the river bank and slug it out. The army which could summon enough power to cross a river in the face of the enemy resistance usually had enough power to smash the opponent on the opposite side.

But nowadays aerial warfare has made river crossing a routine operation in a larger, more fluid form of fighting. There are few opportunities in the battlefield of today to build bridges desired as semi-stationary structures. Airplanes zoom down out of the sky and knock a bridge to pieces in a matter of seconds. Thus the mobile war demands a different technique in getting troops across. It has turned the engineers to the pontoon bridge and the ferry system. These pontoon bridges and rafts, or ferries, can be built rapidly, and dismantled just as speedily. They serve the same purpose as a more costly bridge, and they can be transported easily and almost be tossed across a stream at will.

One of the smartest military bridge-building feats of World War II was performed by the Russian engineers on the Rzhev front. A Russian military engineer by the name of Sosnovkin and his brave little band of men stood not far from a river on the Rzhev front.

Across the river on the opposite bank the Germans were holding an hourly vigil punctuated at intervals by the spurts of fire and shell they threw into the Russian ranks. Engineer Sosnovkin knew he had to get across. In doing so he faced heavy odds. It would be difficult building a bridge without being caught by a German sentry patrolling near the opposite river bank. Engineer Sosnovkin made a decision. He would build a bridge quietly, and when it was completed the Germans wouldn't even know it was there. He outlined his plan quickly to his engineer crew and they went to work. During the ensuing nights the men practiced building on their side of the river.

The engineers planted their bridge pillars in firm foundations of stone but didn't let any part of the pillar or top cross-pieces extend above the surface. They fastened the pieces together with nuts and bolts coated with oil. They literally had to feel their way through each intricate operation in the icy water and under the cloak of darkness.

The Russian side of the river was comparatively flat and easily observed by the Germans on the other side. So Engineer Sosnovkin sent his men across the river to the opposite high steep bank and told them to build the bridge from the German side. The night they began, the moon was hidden by clouds, and snow swirled down in a heavy fog-like cloak to the river's surface. The husky engineer swimmers moved quietly through the frigid water weighted with the foundation stones piled in improvised stretchers.

Other engineers swam almost silently through the water pushing the log piling. Fiercely bitten by the freezing cold, they planted and laced together the first sections of the bridge, none of it protruding above the surface. That first night the Germans patrolling the area fired at the strange sounds coming from the river. Several of the engineers were injured. But the Russians came back the second night, more stealthily and quieter than ever.

When the bridge had been completed, Engineer Sosnovkin slipped to the edge of the river on the Russian side and drove stakes

Two M-3 tanks and a jeep put a ponton bridge to work. The speed and efficiency with which engineers string this type bridge across a stream is amazing. Endless hours of training with armored forces equip the engineers for the job. At lower left a machine gun is perched on a ponton to stand off attack.

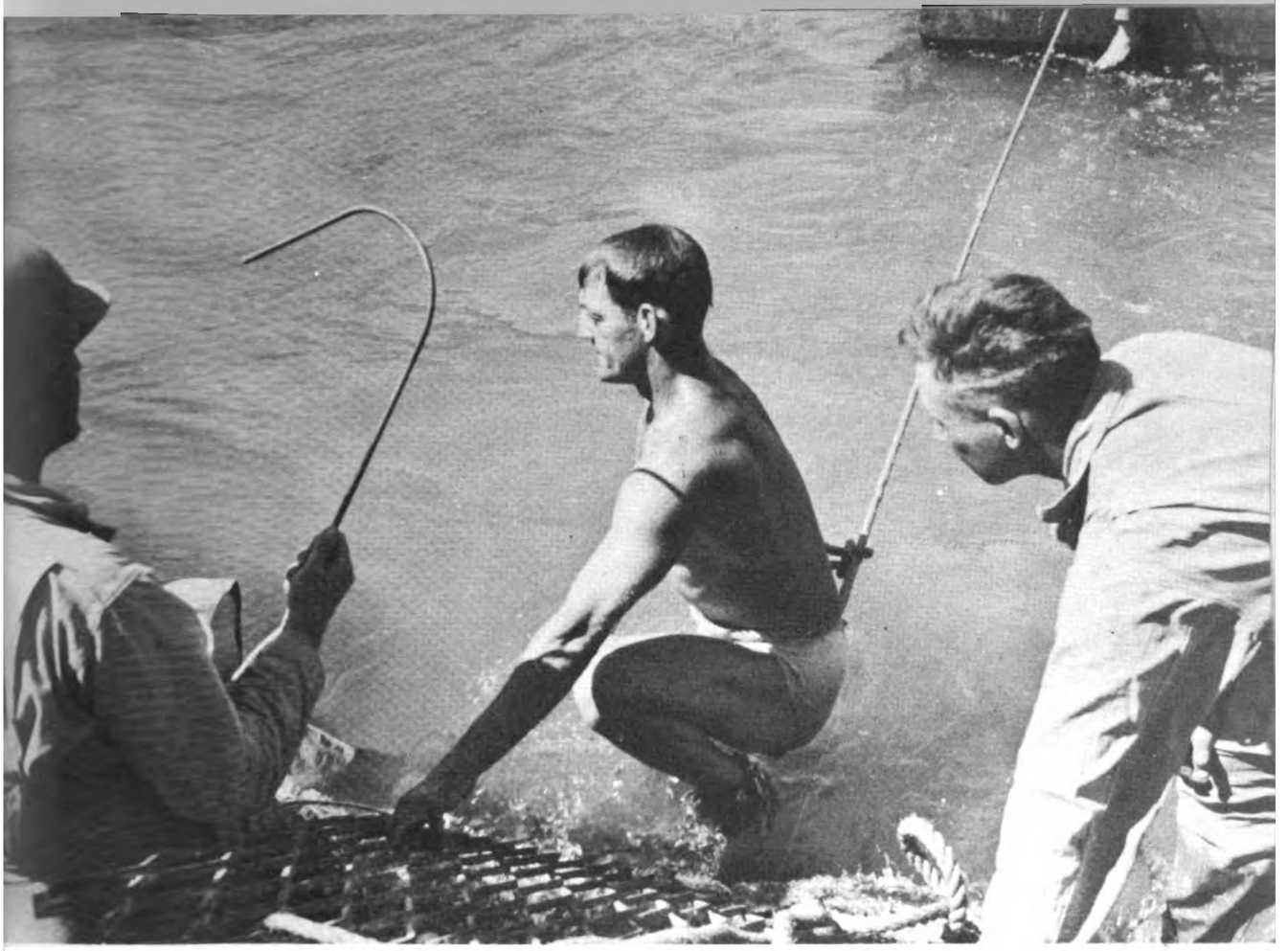
in the bank at the exact location of his bridge. Sosnovkin's eyes glinted at the ominous haze. A cold, steely smile crept across his lips, blue with bitter cold. He worked his way back to his men, crouched in their concealed position not far from the river bank.

They waited patiently. Then suddenly the ground trembled and shuddered. The big Russian guns opened up. Shells screamed across the river and blasted into German positions. Russian tanks moved up to the river. They were painted white to match the snow-carpeted terrain. The first tanks broke through the thin ice coat and their treads cautiously crept onto the bridge. Then the first squadron rushed across. Then came another and another, until a wave of these steel monsters plunged on into the Germans and fanned out on the opposite bank. An engineer bridge had opened the Rzhev offensive and the Germans started a hasty retreat.

One bit of information the engineer soldier picks up right away is that the enemy is going to destroy every bridge he crosses in retreat. In so doing he slows up the pursuers. Thus the engineer's job is to get across regardless—and quickly. So in training for river crossings, engineers assemble bridges, inflate pontoon boats and get their assault boats into water under the scrutiny of an officer holding a stop watch. Every moment counts. It counts in battle and it counts in training.

To start off, the engineer learns that a long fixed bridge is supported on abutments at each end and upon intermediate trestles or piers. The engineers don't put all their eggs in one basket for river crossing. They have a lengthy list of methods and different types of bridges. The most common military fixed bridges are the simple stringer bridge, the trestle bent bridge and the portable steel bridge. These bridges are designed to carry tremendous loads and do, up to many tons. It takes sturdy bridges to carry some of the big tanks and heavy armored trucks and equipment.

The simple stringer bridge is usually short. Stringers are beams carrying the bridge floor. These stringers are supported by two abut-



Stripped to barest essentials this engineer is lashed to a ponton boat while he works in swift water to set bridge fittings into position.

ments, one at each end. Two types of abutments are used, one for use with soft-approach roadways, and the other for use with firm roadways. Every engineer soldier is taught how to construct a simple stringer bridge.

Trestle bridges are merely a succession of simple spans in which the trestles take the place of abutments. Timber stringers are seldom used in spans over 15 feet; steel beams in spans over 25 feet.

In the trestle bent bridge, two or more stringer spans are used if a bridge longer than a simple stringer bridge is necessary. The trestle bent bridge is supported by an abutment at each end, and by intermediate supports called "trestle bents."

The portable steel bridge consists of two girders which can be assembled by hand to a length of 72 feet, supporting a one-track timber deck. The 12-foot sections are carried in trucks and bolted together to construct the bridge. There is a larger portable steel bridge used by the engineers called an "H-20," built in the manner described above except that it requires a block and tackle to swing the heavy sections into place. It is capable of carrying a load up to 20 tons.

The floating bridges the engineers build are generally of three types: portable foot bridge, and light and heavy pontoon bridges. The heavy pontoon structure will carry up to 25 tons and can be assembled very rapidly.

Captain Eddie Rickenbacker is an avowed booster for the pontoon. And so are many other pilots who have been lashed by wild waves in unknown reaches of the ocean after their planes developed motor trouble or were shot from under them. The pontoon boats which saved Rickenbacker and his gallant crew are not very different from those the engineers use to make pontoon bridges. They may be sturdier, but their construction is essentially the same, and they are extremely efficient. Once squads of engineers heaved and tugged to get heavy wooden boats into the water as a support for a pontoon bridge, but the new rubberized version can be tossed about by a few

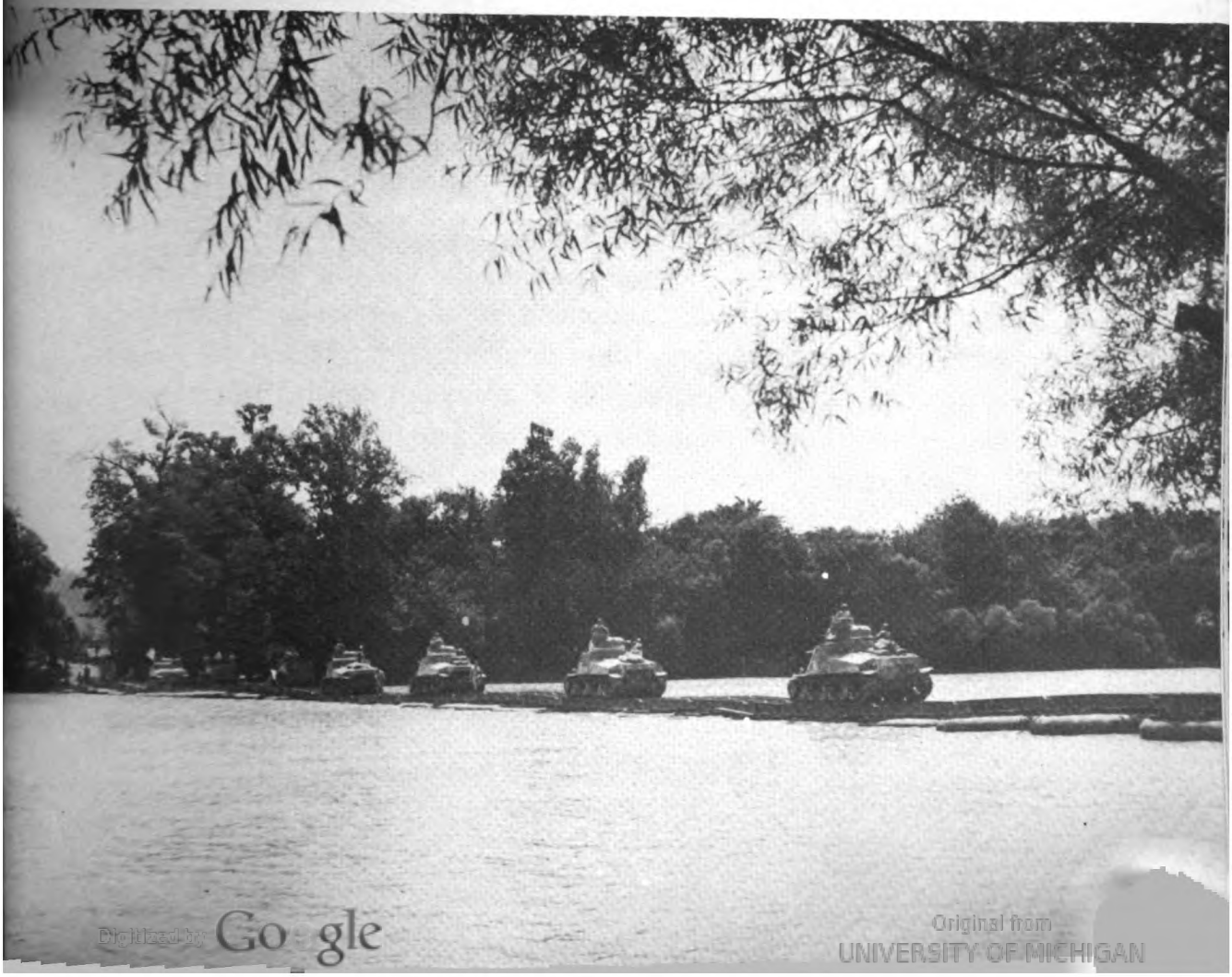
The engineers are super-specialists in stream crossing. Here an engineer-operated rubber raft transports a gun crew and two 37 mm guns across a river.

If an engineer doesn't have the equipment he makes it. Here is a lesson in "improvisation," for visiting congressmen, as well as engineers ashore. A foot bridge improvised from oil drums, rope, and light lumber.

On maneuvers in Georgia the Chattahoochee River bends to the will of the engineers who throw an air-filled rubber ponton bridge across for a light tank. Were the scene in the Solomons or Alaska there would be little difference in construction or approach.

Here the engineers have completed a foot bridge and the infantry has just started streaming across. Once troops are safely across, the bridge can be removed quickly.

Much of the swift striking power of an armored force is wrapped up in ability of engineers to bridge a stream. Here five M-3 tanks and two half-tracks roll across a ponton bridge in a maneuver.



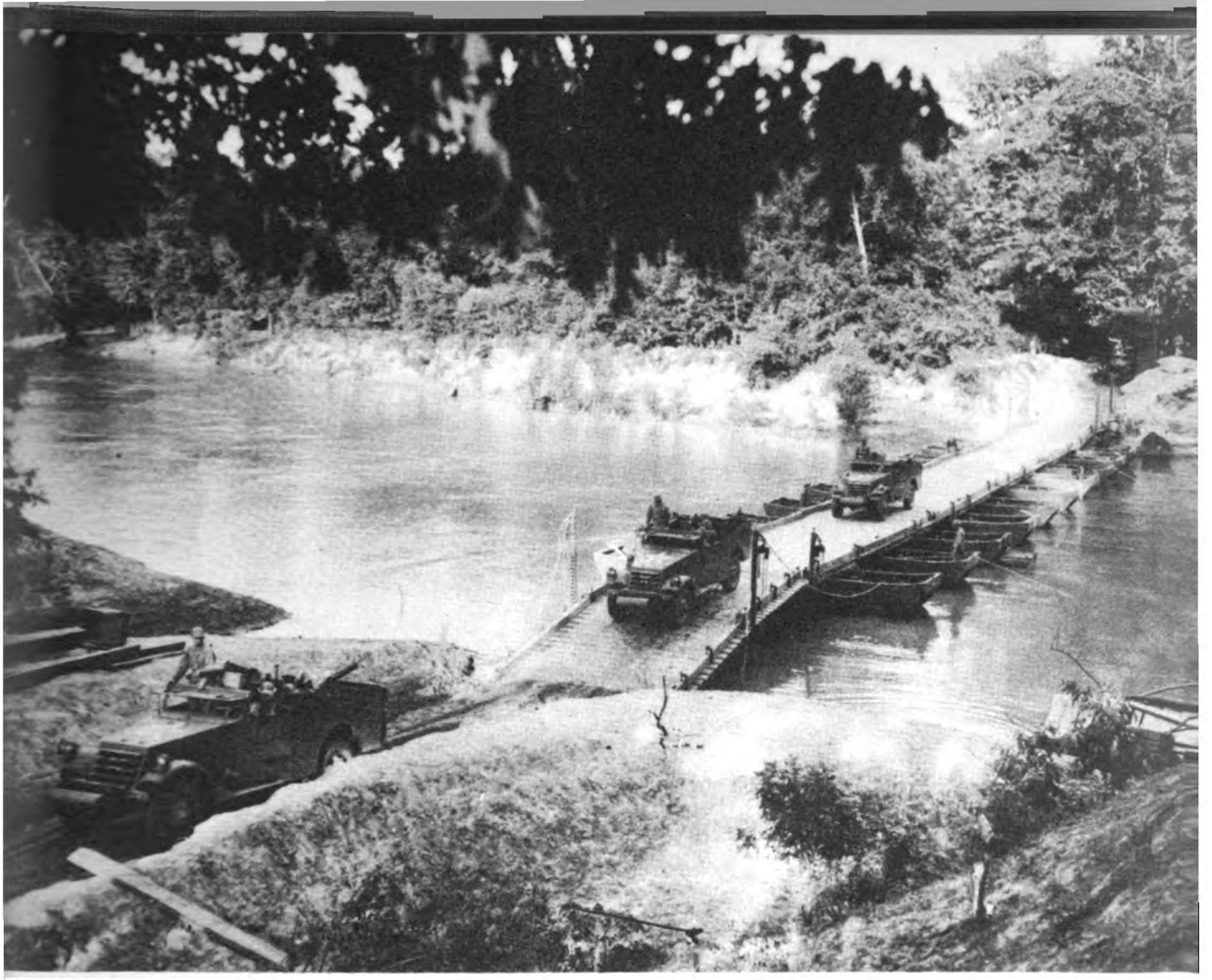
men. Its water-sealed compartments make it comparatively safe from snipers' bullets. A bullet may puncture one compartment, but the others will hold because of check valves between each compartment in the pontoon. The new pontoon used to make bridges can, when deflated, be stored neatly in a truck compartment. On its sides are fittings of metal which hold the two tracks in place as they are laid across a stream. The tracks are like steel ruts, a few inches wide, and it would be difficult for a wheeled vehicle to get off the track if it wanted to. Huge tanks and armored vehicles rumble across one of these bridges like giant tumblebugs in wagon wheel ruts on a country dirt road.

When the engineers swing into action to erect a pontoon bridge trucks wheel up to the stream's edge. Men jump out of the trucks, drag the pontoons out of the special compartment, stick a hose on the valve and inflate the pontoon from a compressed air tank carried on the truck; it's just like filling a tube from a reserve tank on an automobile. Other engineers unload the steel tracks.

Members of the crew float the pontoons into position, drop anchors and lock the pontoons together. Meanwhile other engineers are rushing across the first stretch of the bridge, laying the steel track in place. As soon as it is finished, the artillery and tanks crawl out on the bridge and up the bank on the opposite shore. Trucks which trundled the bridge equipment to the river's edge follow suit. Back the engineers go and begin dismantling the bridge. It comes apart as quickly and mechanically as it was put down. Pontoons are dragged to the bank to dry, then are loaded on trucks and off they go.

The engineers have other methods of licking a river. Engineer soldiers often will be called out to paddle assault boats and row light pontoon boats, or operate light outboard motors attached to these same boats in getting troops across.

The assault boat is a 200-pounder. It is a flat-bottomed, plywood skiff used to carry the leading infantry troops across the water in an attack on a river line, or to establish a bridgehead. Normally, one of



Here motorized infantry pour across a bridge hurriedly constructed by engineers. For this river-crossing engineers trucked ten ponton boats to the river bank, shoved them into water, unloaded the bridge floor in sections, and laced the bridge together.

In this action assault boats of an engineer battalion arrive on an "enemy shore" after crossing river in training. Infantry men charge from assault boats onto the shore. The engineers have come across to establish a bridgehead.

Although new type "seamobile" equipment adaptable to either land or water is now being manufactured, the engineers don't wait. They simply drive a jeep onto a heavy tarpaulin, tie up the corners, and float the jeep across.

these boats can be lugged along for a short distance by from four to ten men, depending on the terrain. Once in the water, it will haul a cargo of nine infantrymen in addition to its engineer crew of two. The engineer, standing in the stern or kneeling, whichever is the desirable position at the moment, is the boat's commander in its short overwater journey.

His men kneel on the knee nearest the side or take any comfortable position, holding the paddle so the hand next to the water grasps the handle just above the blade. Then away they go. However, this boat is normally used where great secrecy is in order and the men have to be careful not to make noise, splash water or knock the paddle against the boat's side. They're trained to propel these boats as Indians paddle a canoe.

Many an angler who probably will be without an outboard motor for the duration will control his temper when the manufacturer politely informs him by letter that he can't furnish a motor or parts because the Army engineers are using a considerable batch of them. A 4.5-horsepower outboard and a 22-horsepower model are standard equipment for propelling assault boats and light pontoon boats when there is no specific need for noiseless operation. However, the engineers are using more and more motors, sacrificing cautiousness for speed in water movement.

The engineers are demons for efficiency, even if it's only rowing a boat. Here's how the engineer is taught to paddle his way into a career as an oarsman of no mean ability:

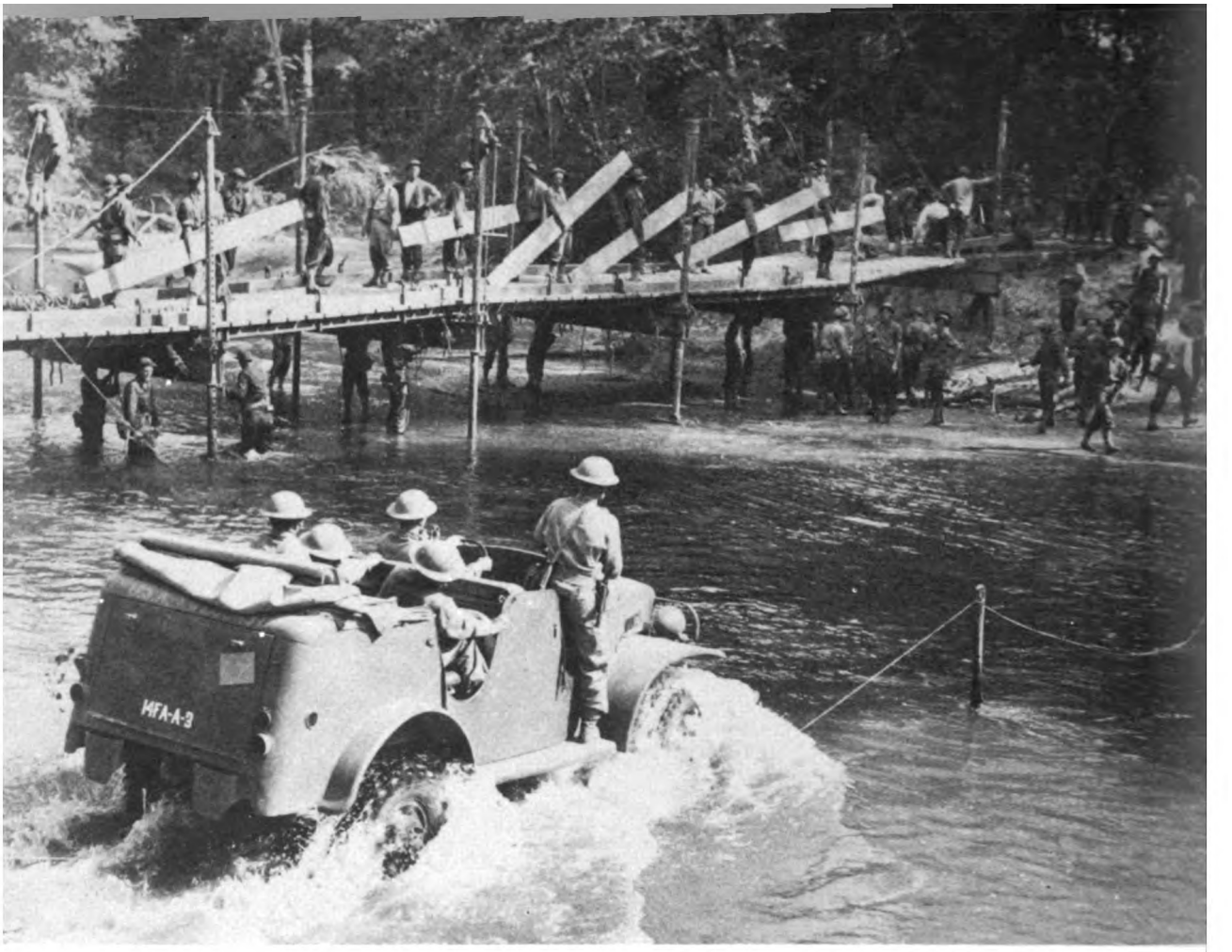
He piles into the boat with the crew. At the command, "Attention!", the oarsman inserts the rowlock in the socket; then, facing the stern of the boat, places himself in the middle of the pontoon abreast of his rowlock, assuming the position of attention.

"Up Oars," shouts the boat's commander. The engineer grasps his oar and raises it briskly to the vertical in front of the center of the body, the handle resting on the bottom of the boat, with the blade turned fore and aft. With the hand next to the rowlock he grasps

Engineers are masters at land and water "locomotion." Here they have rigged a workable ferry out of ponton boats powered with outboard motors. By rigging the ferry to a height of several feet the tank can better negotiate steep banks on opposite side of river.

One section of a ponton bridge being floated into position. Other sections will follow in rapid succession to complete the bridge.

Here a completed ponton bridge serves a scout car on patrol whipping hurriedly across the stream to escape enemy fire.



Engineers are rushing construction of a bridge over a shallow stream. A command car approaches and can't wait for the bridge. Engineers string a marker cable and the command car rushes on across the stream.

In training, engineers learn all types of bridge construction. Here they assemble ponton sections of floating treadway bridge. Type of bridge required depends on character of motorized equipment of the military unit. Armored force requires heaviest bridges for giant tanks and half tracks, and cargo trucks.

the oar at the height of the chest, elbow and wrist horizontal, the other hand steadying it 12 inches lower.

"Let Fall!" comes the next command. At this, he moves his foot on the side opposite the rowlock 18 inches perpendicularly (if a heavy shell lands near by he doesn't bother counting inches) toward that side and allows the oar to fall outward so that the blade strikes the water flat, while the shaft is held clear of the gunwale. The oar should not fall upon the rowlock, but is placed gently therein with the handle and blade horizontal. One hand holds the grip and the other is on the shaft 8 inches from it, the backs of both hands up and the wrists lowered; the foot next to the rowlock is moved 18 inches to the rear. Only 3½ feet of the oar should be inside the pontoon gunwale. This then is the position taken at the command, "Oars."

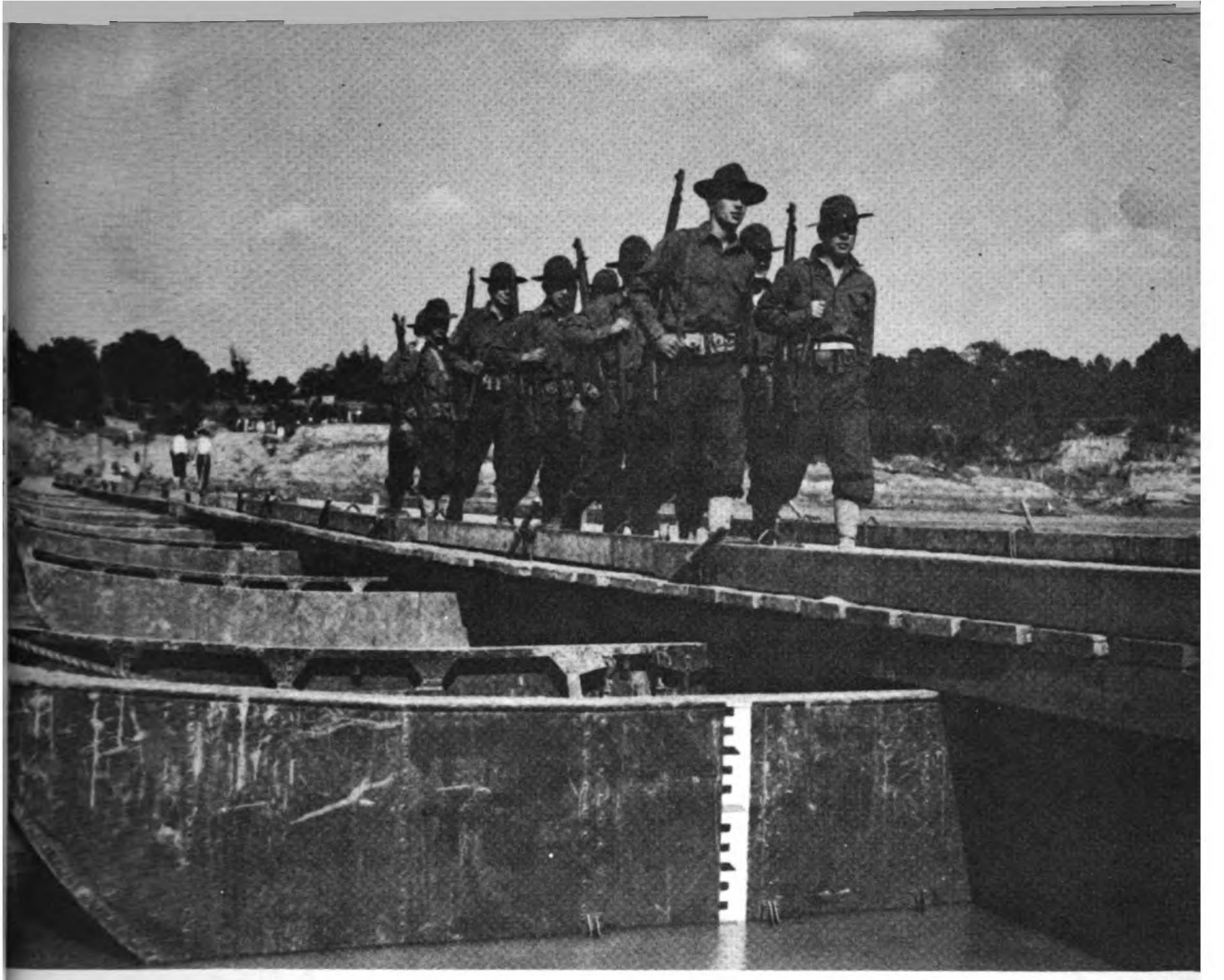
"Give Way," says the man at the stern, and the engineer extends the arms and throws the weight of the body well forward.

At the limit of the stroke he raises his wrists, drops the blade vertically into the water, throws his weight strongly backward and pulls the blade through the water at constant depth, but not too deeply.

At the end of the stroke he lifts his blade from the water, bending down his wrists to feather the oar, and recovers his first position. These motions are repeated with regularity, taking care to follow the stroke oarsman nearest the stern, to make long sweeps, to keep the blade horizontal near the water by depressing the wrists after every stroke until the command, "Way Enough" or "Oars," is given, and to pull with the legs and weight of the body rather than with the arms and shoulders.

At the command, "Way Enough," given when the oar is in the water, the oarsman takes one more stroke, raises the oar to a vertical position, and then lays it gently just inside the gunwale with the blade toward the bow.

At the command, "Oars," given when the oar is in the water,



A close-up of the ponton boat and heavy timber engineers use in construction of such bridges. This type of bridge carries a load of many tons and can be assembled or dismantled quickly. Because of tremendous weight and cargo space required in transportation these boats are being rapidly replaced with rubber pontons which can be deflated and moved more easily.

Belting rubber pontons together to make a raft. When completed these three boats constitute an improvised ferry of great strength. It will accommodate a command car or light truck, or medium calibre field gun.

Engineers use mechanized equipment at every turn. Bulldozers here are scooping out a roadway at the end of a ponton bridge concealed behind river bank.

the engineer takes one more stroke, if rowing, and assumes the "Oars" position. If at the position "Hold Water," the stroke is omitted. At the command, "Hold Water," given at any time, the oarsman engages the blade in the water, the engineer holds the oar firmly at right angles to the pontoon, and gradually brings the blade vertical to check the headway when in motion.

"Stern All" is still another Army rowing command. In effect, it is the engineer's signal to reverse the operation of his oars and gradually reverse the direction of the boat. This operation is halted with the command, "Way Enough."

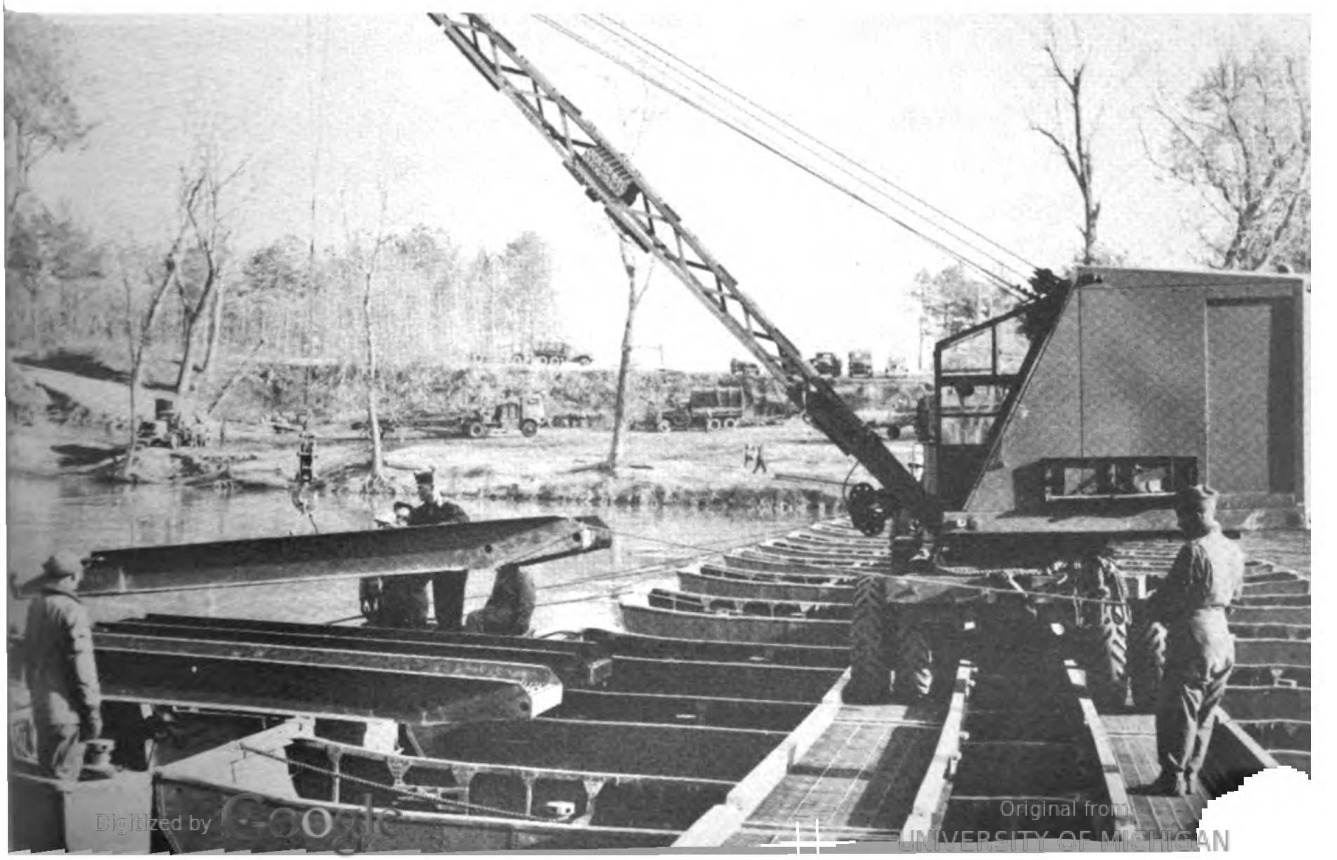
When the engineer coxswain gives the command "Unship," the crew finishes the stroke, if rowing, removes the oar from the rowlock and lets it trail astern alongside, held by the hand next to the gunwale. This is an action to prevent fouling the oars if the boat is moving through a narrow channel or between bridge piers. Once through the water obstacles, the man in the stern shouts, "Ship Oars," and the men hustle the oars back into their operating positions.

There are other commands for different boat maneuvers, some of which might be directed to men on one side of the boat only, to change course or direction; but the man who holds the envied position is the noncommissioned officer in charge who sits in the stern, gives the signals and manipulates the rudder oar.

Except in building the Alcan Highway, where the engineers' trustiest aides were often the pontoon boats, and where they built 200 bridges, aside from many temporary and emergency crossings, they have had little experience in this war business. "What about these engineer bridge builders and pontooneers?" I asked an officer in Washington. "Don't worry," he said. "We may have to cross all the rivers in Europe yet!"

Equipment of a heavy bridge building battalion on the move. Loaded on giant trucks these huge boats are rushed across country with speed equal to that of other fast armored vehicles.

The engineers harness a crane to a bridge building job for the Armored Force. The entire operation, clumsy in appearance at first glance, can be accomplished in a few hours by engineers. When completed the bridge will carry the heaviest armored equipment.



Chapter Fifteen

PLANNING FOR ACTION

UP TO THE TIME THIS IS written, the engineers have cut one of the boldest and most striking patterns of action yet seen on the home, planning, training or battle fronts. There are thousands of vivid examples, but the most stirring and heartwarming of all was the skillful and diligent planning and execution of the engineers' participation in the North African campaign.

Long before Pearl Harbor the engineers had been slashing through red tape, political barricades, investigations, committee hearings and drum beating to get a roof over the heads of an Army multiplying into the millions in a matter of months. Then the Commander-in-Chief passed the word along to gear up for the first land offensive beyond the Atlantic for American troops. And the engineers were ready.

Data were already on hand at the War Department in Washington that would be necessary in assembling, loading and transporting millions of pounds of food, clothing, guns and medical supplies to ports of embarkation. The engineers were short-handed from the start because of the drain on engineer talent made by the tremendous expansion of every vital war industry in America. But they had studied every detail of dozens of different types of plans for just such a move as would be required, even though it was to be the biggest in history.

It is possible the engineers could not foretell the exact scale of the invasion plans in advance. But they had only to double, triple or

quadruple scientifically prepared plans of smaller proportions which they had been drawing and accumulating with every contingency that developed on the dozens of battle fronts around the world.

A stop watch is a simple instrument, but highly significant to an engineer. From the hour the decision to embark for Africa was handed down to the Corps of Engineers their every movement and operation was timed, calculated and recorded by the stop watch's minute hand. They had little more than a dozen weeks in which to do the job. But the well-oiled machinery of the Corps of Engineers operated at a pace that assured the movement, loading and unloading of mountains of supplies and hundreds of thousands of troops at their destination.

While a hot summer sun slowly climbed into a muggy haze over a tense Washington, the headquarters of the Corps was like a beehive without the familiar buzz, for secrecy was one of the "musts." Success of the campaign rested on shoulders of the tight-lipped Engineers' officers. They alone had to draft intricate plans for machinery, tools and equipment and work out the smoothest, most efficient methods and routes by which to get men and machines to the take-off spot at the precise hour, without a hitch.

More than half a million items of war had to be moved on schedule, in packages, bundles, crates, boxes and bags. It was up to the engineers to determine whether they were to be dismantled, rolled, wheeled, trundled, skidded, or swung over the side of the ship and into the hold from the docks at the embarkation point. These items of war were to constitute the most varied assortment of instruments, gadgets, machines, clothing, food, explosives, guns, tanks, boats and sundry other articles ever to be assembled at one time for one expedition.

If the ingenuity of the Corps was ever put to the test, this was the time. Hundreds of thousands of maps, charts and aerial photographs had to be drawn and reproduced. Many of them had to be revised and redrawn. Then they had to be packaged and marked for dis-

tribution to appropriate personnel at the scheduled hour. Topographic and geological studies of every single mile of territory from Cairo to Dakar were scrutinized for the most minute detail of value to the eye of a soldier.

Facts by the volume were uncovered by the engineers. They tracked down in their painstaking search every clue that would make the going easier for our troops, once they landed. Streets of Casablanca and Oran; roads leading to these towns; their harbor and port facilities; water mains, communication lines, and detailed facts of the surrounding terrain's geography were named, marked and mapped with amazing precision.

This huge collection of military information was carefully indexed, then translated into language every soldier could understand, whether he was private or general. Finally it was printed into handy form that could be used in the field of battle, wherever the soldier went ashore.

Location in Morocco and Algeria of all railway facilities, storage tanks, telephone lines, hospital facilities, and radio stations was of vital importance. It was necessary to know the gauge of railroads, types of freight and passenger cars, the strength of railway and road bridges, the texture of the materials used in local road construction, and a thousand and one other facts and figures on the natural and man-made resources of every strip of land that fringed the Mediterranean, and for many miles inland.

Many a strange foot followed the path to the doors of the Corps of Engineers offices in Washington during that hectic few weeks. Among the visitors who came and talked with the engineers were men who had searched for precious minerals, oil and odd fragments of history around the Mediterranean and over the sands of Africa.

But the engineers did not wait for all of them to come to Washington. They hopped planes and trains for distant parts of the United States, to talk to a civil engineer in Denver who had once built roads in Morocco; to a geologist in an Oklahoma oil field who once drilled

A stitch in time saves. . . . Well, anyway these engineers have set up shop in temporary quarters. Engineers are rough on uniforms and former tailors in civilian life find they are valuable to the Army too.

for oil somewhere on the African continent; to an importer of goat hides in New York. These and many more world travelers, writers, scientists and salesmen pieced together priceless information for the engineers.

This feverish search for facts progressed around the clock the full twenty-four hours, day and night. Meanwhile things were popping in the field, where engineer soldiers were toiling and sweating under a summer sun that slowly crawled on toward autumn and the eventual zero hour.

For instance, at one unidentified training camp a battalion of engineers loaded boxes, barrels, machinery, packages and drums of all sizes and shapes into the hold of a dummy ship. Immediately they unloaded her. Then came the check-up. How could each operation be speeded? Couldn't some space be saved here? A smoother job done there? Finally, all the paraphernalia was reloaded patiently and more efficiently. At the same time the counterpart of this dry-land cargo vessel was somewhere in an American port being repaired and refitted for its place in the great sea parade to the Axis' back door.

These engineer soldiers must have wondered at times about the sanity of officers who could issue an order to pile tons of material into a dummy ship, especially one perched in the middle of a training camp hundreds of miles from the nearest navigable stream or lake. But they carried on under able leadership of capable officers trained in the thorough manner of an engineer. The unloading and reloading process went on endlessly. When one group of men were sufficiently trained to handle a particular task to which they would be assigned later in the African landing, another crew appeared on the scene.

The entire period of training was a piece of precision education to hundreds of troops who had never seen a boat except in pictures, much less load one. Some of the keen-eyed officers of the Corps had been intimately associated in civilian life with ships, strange ports and the salt tang of the sea. They worked like beavers with other

Responsible for maintenance of water supply, the engineers have adopted many handy aids such as this portable water "cooler" known as the Lister Bag. Here two soldiers enjoy a cool drink.

young engineers fresh from West Point just as finely polished in other phases of complex war.

Meanwhile still other engineers were checking and rechecking schedules of trains and routes, and test-running trains to and from the port of embarkation. Each train had to be on the spot with a certain number of troops at a given time and it was mandatory that it be unloaded in exactly so many minutes. Then, on the dot, it had to be back-tracking to another strategic point for perhaps another load of material or troops, while the next train moved up and discharged its precious freight.

Each step in this tremendous movement of men and materials was synchronized and timed by the stop watch, and the engineers saw that schedules were not abused. It is fascinating to watch the lilt and listen to the hum of the Engineers Corps as it weaves a steely pattern out of fragments of a nation's history. Making history is an Engineers Corps custom.

Chapter Sixteen

ENGINEERS LOOK AHEAD

THE FUTURE OF THE Corps of Engineers will directly depend on the foundation on which the future will be built. The foundation is the men, their equipment, and the proficiency with which they use it. Secretary of War Henry L. Stimson recently gave a vivid report of our Army and its men and equipment in a magazine article. The Secretary wrote that we have an Army of over five million men. Well over one million constitute the Air Force. That figure, the Secretary said, included tens of thousands of pilots. Therefore today we have nearly twenty times as many soldiers in the Army as were in the regular army in 1940. The Army has been raised by the most fair and scientific system of selective service the nation has ever had. Officers of these forces are being rapidly trained. They are chosen by the most democratic methods and educated by the most modern of officer training school systems. Each combat officer is required to spend from three to four months in training with the ranks. The Secretary of War reported that we had the best airplanes, tanks, self-propelled artillery and other equipment in the world, according to unanimous testimony.

The Secretary of War quoted statistics furnished him by the Army's Special Services Division. The figures showed that the average American soldier of today weighs about eight pounds more than his counterpart of 1918. The percentage of our soldiers today who are graduates of high schools is three times that of the last war. Fifty per cent confine themselves to soft drinks entirely; about forty per cent drink beer, and only the very small remainder of about

ten per cent drink distilled liquor. The soldier of today attends the churches the Army has built for him. A larger percentage, the Secretary said, go to their churches at the military camps, posts and stations, than the percentage of our male citizens outside the Army who go to church at their houses of worship.

Today's soldier is a healthy man. The general disease rate is lower than in any previous war. The Secretary explained that the Army is doing all within its power to build both body and character in every soldier. He never once expressed doubt or deep concern over the character, fortitude or determination of the soldiers in our Army. The Army is a team, and the Corps of Engineers is an established and integral part of it. We have had a glance at the man and the quality of equipment in the Army. Thus we know the foundation upon which the Engineers will build for the future.

Thus far the Corps of Engineers has acquitted itself honorably. Engineer soldiers have virtually belted the globe with airfields for our fighters. Once the victory is won, these will be the pearls of an aerial necklace for the commerce that travels the air lanes of the world.

In the realm of construction the engineers have set a record unequaled in the history of the world. If the construction of all the dams, roads, air fields, bridges, army cantonments, war plants, public buildings, parks and utility systems, and the manufacture of war materials, all under the direction of, or built by, the engineers during the past five years could be totaled in man hours, cost, and energy, it would probably surpass all of the labor, expenditures and planning combined in the pyramids of Egypt and the Great Wall of China. For construction and procurement of equipment last year alone, the Corps of Engineers spent the amazing sum of twelve billion dollars.

We have had a look at the Alaskan-Canadian Highway and have seen the "blood, sweat and tears" poured into that mammoth engineering enterprise. As little lights glow from firesides to be strung along this international thoroughfare, and as new homes, farms and

factories, mines and dams rise in the domain the highway pierces to tap the untold wealth, the engineers of the Army will probably be pushing on into new fields, pioneering into the beyond, and furnishing new carpets of magic to the world.

When the Corps of Engineers takes a young engineer soldier to mold him into an officer, the soldier's past record is combed meticulously to measure his personality and the quality of his character. One can peer into the Corps' future by scanning musty historical records and uncovering some startling facts about the Corps' personality and character.

The facts speak strongly. Until 1855 there was hardly a railroad in the country not built by the Corps. The names of Captain William C. McNeill and Lieutenant George W. Whistler will always stand out as pioneers in this work.

These men were detailed to aid in choosing the route of the Baltimore and Ohio Railroad in 1827, the first railway in America. As it turned out they routed it, built it and managed it.

With other engineers these two men also built and managed the Northern Central; the Erie, Boston and Providence; the New York, New Haven and Hartford; the Boston and Albany, and others. Lieutenant Whistler designed and built the best locomotive of the time. His fame was so widespread that the Czar of Russia requested and got the services of this young engineer to build a railway from St. Petersburg to Moscow. During this same period, engineers of the Corps built the Chesapeake and Ohio Canal and the old Erie Canal. The great transcontinental railways were all surveyed and projected by the Corps. The Coast and Geodetic Survey was reorganized and run by an engineer officer for twenty-four years.

Then there are General Benham, who built for General Grant the famous bridge of 101 pontoons, 2200 feet long, across the James River, and General Woodbury, who built the pontoon bridges at Fredericksburg and a famous bridge across the Chickahominy.

Virtually every boundary of the United States and most of the

state boundaries were marked and surveyed by officers of the Corps. Engineers of the Corps practically completed most of our harbors and their facilities, most of the lighthouses along our shores, and the majority of the mammoth locks and canals. Officers of the Corps completed the difficult job of removing the wreck of the battleship *Maine* from Havana harbor. And the Panama Canal is an enduring monument.

An engineer officer of the Revolutionary War drew the plans for the city of Washington. Other engineer officers built the Capital's old fortifications system, the Washington Monument, and the Lincoln Memorial. General Montgomery C. Meigs of the Corps surveyed and located the Capital's water supply aqueduct and superintended the construction of the Capitol itself. General Thomas L. Casey built the old War and Navy Building, then the world's largest, and the magnificent Library of Congress. The list could go on almost endlessly, reaching to the last island outpost of the United States possessions.

Whether it is peacetime or wartime, the bold, straight line of achievement of the Corps of Engineers does not waver. The engineers do not know the meaning of the word impossible. Their motto is "Let Us Try."

replacements brush their teeth daily and have healthy gingiva. Those in both groups who practice daily tooth-brush technique seem to have a slightly less caries incidence than others. Comparing those men with daily care and healthy tissue with the incidence of caries, I found that the veterans in this category have an average of 5.09 caries per man; the replacements, an average of 5.27 caries per man. While slight, the difference shows an inclination toward a lower incidence of caries when daily care is practiced.

SUMMARY

1. A group of veterans with more than two years' service in the tropics was compared with a group of replacements. The veterans were in their late twenties; the replacements were in their early twenties. The veterans averaged exactly the same number of caries per man as the replacements. The veterans (older men) averaged two more restorations per man than the replacements. There was no significant difference in the number of teeth which were missing or had to be extracted at the time of examination in both groups.

2. The majority of the veterans had had malaria, and about one-half of them had had ten or more attacks. Only 8 percent of the replacements had had malaria from one to three times. Those men who had had malaria many times showed a higher incidence of caries. These same men did not require more than the average number of extractions nor were they missing more than the average number of teeth. Those men with malaria one to ten times had the average number of carious teeth.

3. The veterans have better oral hygiene habits. The gingival tissue of the veterans is, on the whole, healthier than that of the replacements. The replacements have less calculus and recession of gingival tissue. Those men who practice daily oral care have slightly fewer caries than the average.

CONCLUSION

There was very little if any difference in the incidence of caries, number of teeth missing or requiring extraction, or other dental disorders between a group of United States soldiers who had more than two years' service in the tropics and their replacements.

WD Circular No. 447 24 Nov. 44 Sect. IV	Directions for disposition of dental material removed from the mouths of Army dental patients are contained in this section.
WD Circular No. 449 25 Nov. 44 (Restricted)	Suppressive therapy for malaria among troops returning from overseas will be discontinued the 29th day after their arrival except when specific indications exist for its continuance.
WD Circular No. 454 29 Nov. 44 Sect. III	Prescribes manner of wearing new honorable discharge emblem on uniform of all military personnel who have been discharged or separated from service under honorable conditions.

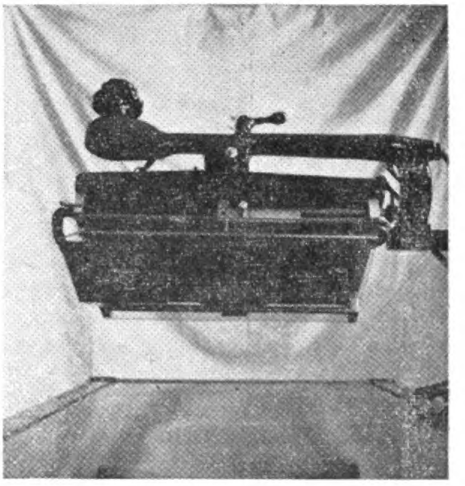
(See also page 59.)

Apparatus

SPOT FILM DEVICE FOR ARMY RADIOGRAPHY

CAPTAIN STANLEY M. WYMAN
Medical Corps, Army of the United States

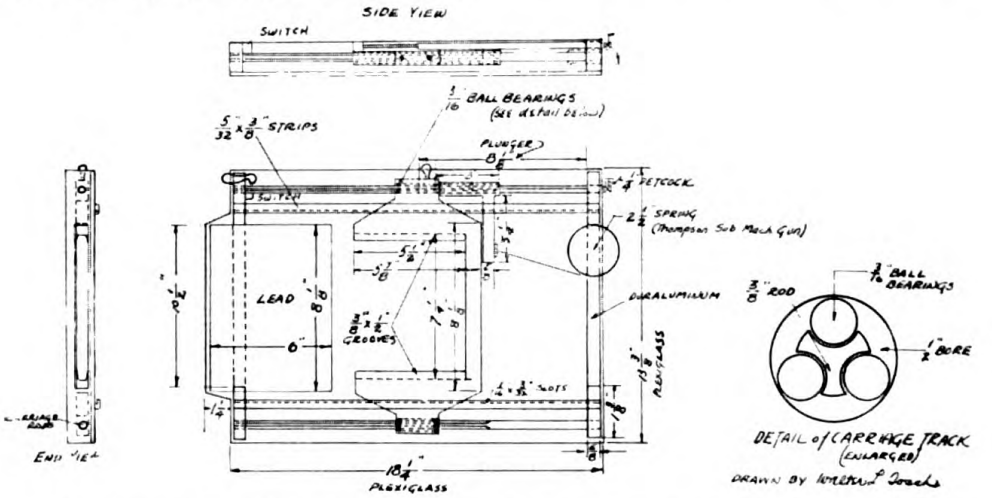
The roentgenologic service at this hospital has long felt the need for a device to obtain a permanent record of fluoroscopic findings. Such mechanism is not available on the standard 200-Ma. General Electric radiographic-fluoroscopic unit supplied by the Army, and only recently has it been possible to improvise one through the cooperation of the 98th Ordnance Company, Heavy Maintenance Tank. With designs submitted by this service and using scrap materials and parts, they have made a very satisfactory device, which consists of a frame of duralumin corresponding to the size of the fluoroscopic screen mounting. The frame has two end pieces connected by two steel bars constructed of drill rods of ⅜-inch diameter, each provided with three 3/16-inch grooves. The carriage is cut from a single piece of duralumin, embodies a slot in which the cassette is placed, and runs on the steel bars by means of three 3/16-inch steel ball bearings placed at each corner of the carriage. The frame is attached to the underside of the screen mounting by bolts threaded into the mounting. Motive force for the carriage is provided by a circular spring from the drum of a submachine gun magazine. Braking power is obtained by a pneumatic tube of steel mounted on the same side of the frame as the spring to reduce torque and binding of the carriage. A steel plunger with a leather washer at its end is embedded in the carriage and slides in the tube. Regulation of the amount of braking force desired is governed by a valve, improvised from a radiator petcock and placed at the end of the tube. A spring catch automatically holds the carriage at the extreme left side of the frame and when released it permits the carriage to be pulled by the spring into the center of the visual field. Bolted to the under side of the frame is a single large sheet of plexiglass to which is attached a stationary sheet of lead to shield the film until it is to be exposed. There is also a slide on the under side of the plexiglass into which fits a sheet of lead with a central cone of aluminum for taking films with compression. This may be pushed aside during normal fluoroscopy. This device is designed to accommodate a British cassette measuring about 5½ by 7¼ inches. However, the design can be modified so that the carriage will receive a standard 8- by 10-inch cassette, placing the cassette horizontally instead of vertically, thus making it possible to take two exposures on a single film.



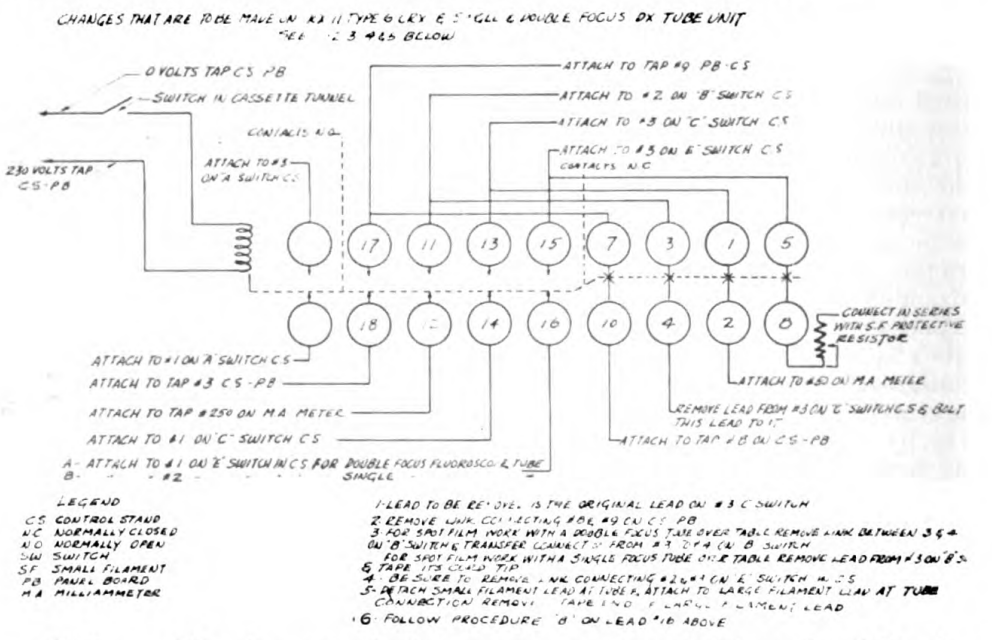
The current in the fluoroscopic tube is automatically changed from fluoroscopy to radiography by means of a push switch mounted on the left side of the frame. This switch is opened by contact with the carriage

Lieut. Colonel J. R. Lingley, M. C., contributed helpful ideas, and Technician Third Grade Cloyce C. Carter and Technician Third Grade Walter L. Tosch gave valuable assistance in the electrical problems and drawings, respectively.

when the carriage is in position for fluoroscopy. It closes on releasing the carriage and in turn activates a double-throw, solenoid type switch having five contacts. The fluoroscopic tube is so wired that only the large focal spot is used, thus obviating a shift of the image on the screen in changing from the small to large focal spots.



To compensate for the added weight on the fluoroscopic arm, it was found necessary to shorten the rod at the upper end of the long coil spring which holds the fluoroscopic arm in the horizontal position. Counterbalance in the vertical position is easily regulated by adding sheet lead to the carriage under the table. When properly adjusted, the fluoroscopic arm is no more difficult to control than without this device.



This machine is convenient, easy to operate, and has the following advantages over many of the commercial models: (1) An unusually wide field of vision is available for routine fluoroscopy. (2) The small size and light weight of the device permit easy palpation during all fluoroscopic examinations.